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State of Connecticut

The Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

Bulletin 211

BEING THE

EIGHTEENTH REPORT OF THE STATE ENTOMOLOGIST FOR 1918

W. E. BRITTON, PH.D.

EIGHTEENTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1918

(Being Bulletin 211 Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, PH.D.

State Entomologist

NEW HAVEN, CONN.

1919

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

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Entomology.	W. E. Britton, Ph.D., *Entomologist; State Entomologist.* B. H. Walden, B.Agr., *First Assistant.* I. W. Davis, B.Sc., M. P. Zappe, B.S., *Assistants.* Miss Martha de Bussy, *Stenographer.*
Forestry.	Walter O. Filley, *Forester, also State Forester and State Forest Fire Warden.* A. E. Moss, M.F., *Assistant State and Station Forester.* Miss E. L. Avery, *Stenographer.*
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Vegetable Growing.	W. C. Pelton, B.S.

* Absent on leave. In service of the United States.

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BULLETIN 211

EIGHTEENTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I submit herewith the manuscript of my eighteenth report as State Entomologist of Connecticut for the fiscal year ending September 30, 1918. It includes brief reports of the inspection of nurseries, imported nursery stock, apiaries and suppressing the gipsy moth, provided for by act of the legislature; also separate accounts of a number of insect pests embodying the results of study and observation of members of the staff of this department; and finally a discussion of the European Corn Borer a destructive pest now present in Massachusetts, and greatly menacing Connecticut though happily not yet known to be present within the State.

Respectfully submitted,

W. E. BRITTON,
State and Station Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1917, TO SEPTEMBER 30, 1918.

RECEIPTS.

From E. H. Jenkins, Treasurer	$6,000.00	
Account of 1917, Balance	986.71	
State Comptroller, Gipsy Moth Acct.	257.09	
L. Hershman, old paper	1.53	
M. P. Zappe, Automobile Mileage	9.72	
W. E. Britton, " "	3.96	
		$7,259.01

EXPENDITURES.

For Field, Office and Laboratory Assistance:		
B. H. Walden,* salary	$1,166.62	
Q. S. Lowry,** "	583.30	
M. P. Zappe, "	1,399.96	
K. F. Chamberlain, "	189.57	
J. S. Miller, "	18.00	
Grace A. Foote,*** "	675.00	
Martha de Bussy, "	78.60	
		$4,111.05

* Remainder paid from appropriation for elimination of mosquitoes.

** Resigned March 1st to accept a higher salary elsewhere.

*** Resigned August 10th to accept a higher salary elsewhere.

EXPENDITURES (*Continued.*)

Printing and Illustrations	$8.40	
Postage	70.76	
Stationery	23.63	
Telegraph and Telephone	2.85	
Office Supplies	9.50	
Library	108.80	
Laboratory Supplies	63.60	
Express Freight and Cartage	6.51	
Machinery, Tools and Supplies	851.72	
Travelling Expenses	308.20	
Insurance	123.61	
Automobile Tires and Repairs	129.67	
Balance, cash on hand	1,440.71	
		$7,259.01

Memorandum:—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The item of $257.09 credited as having been received from the State Comptroller is a transfer from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, and covers the time and automobile mileage while members of the department force were engaged in inspecting imported nursery stock.

PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1918.

By W. E. Britton:

Seventeenth Report of the State Entomologist (Bulletin 203) 142 pages, 4 figures, xxxii plates; 10,000 copies distributed in August.

Report of Committee on Injurious Insects, Proceedings Connecticut Pomological Society, 2½ pages, page 46, May, 1918.

The Apple Aphids and the False Red-Bug, Proceedings Connecticut Pomological Society, 5 pages, 4 illustrations, page 63, May, 1918.

Report of Committee on Insects and Diseases, Report Connecticut Vegetable Growers' Association, 3 pages, page 11, May, 1918.

About Mosquitos and Flies, Bulletin New Haven Board of Health, 3 pages, May, 1918.

Some Insect Pests of Cultivated Plants, The Garden Guide, 17 pages, illustrated, page 260, March, 1918. A. T. DeLaMare Company, Inc., New York.

Some Insects Injuring Nut Trees, Proceedings Northern Nut Growers' Association, Eighth Annual Meeting, Sept. 5 and 6, 1917, 7 pages, page 73, 1918.

Prune Heavily and Burn Twigs to Destroy Pests, Connecticut Agricultural College Press Bulletin, 1-3 column, April 17, 1918.

Spraying as a Preservative, Connecticut Agricultural College Press Bulletin, 1 column, May 15, 1918.

Worm Attacking Iris Roots, The Florists' Exchange, Vol. xlvi, page 245, August 17, 1918. (Brief note.)

By W. E. Britton and G. P. Clinton:
Spray Calendar (Bulletin 199) 48 pages, with card back and 97 illustrations; 11,000 copies distributed in February, 1918.

By A. W. Yates, Apiary Inspector:
Beekeeping for Connecticut (Bulletin 205) 24 pages, 19 figures, 4 plates; 10,000 copies distributed in August, 1918.

By H. W. Coley, Apiary Inspector:
Diseases of Bees; Their Detection and Treatment, Bulletin of Immediate Information, No. 8, 4 pages; 2,000 copies, issued in May, 1918.

SUMMARY OF INSPECTION AND OFFICE WORK.

285 samples of insects received for identification.
88 nurseries inspected.
87 regular certificates granted.
13 parcels of nursery stock inspected and certified.
30 orchards and gardens examined.
73 shipments, containing 387 cases, 830,035 plants imported nursery stock inspected.
21 shipments or 28.7 per cent. found infested with insects or fungi.
395 apiaries containing 3,047 colonies inspected.
39 apiaries containing 99 colonies found infested with European foul brood.
4 apiaries containing 10 colonies found infested with American foul brood.
1 apiary containing 1 colony found infested with pickled or sacbrood.
1 apiary containing 1 colony found infested with bee paralysis.
1774 letters written on official work.
368 post cards written on official work.
78 reports of inspection to Federal Horticultural Board.
740 bulletins, etc., mailed on request or to answer inquiries.
43 packages sent by mail or express.
17 lectures and addresses made at institutes, granges, etc.

DEPARTMENT STAFF.

W. E. BRITTON, Ph.D. ..... *State and Station Entomologist.*
B. H. WALDEN, B.Agr. ..... *First Assistant.*
*QUINCY S. LOWRY, B.Sc. ..... *Assistant.*
MAX P. ZAPPE, B.S. ..... *Assistant.*
**IRVING W. DAVIS, B.Sc. ... *Assistant and Deputy in Charge of Moth Work.*
JOHN T. ASHWORTH ..... *Assistant and Acting Deputy, Moth Work.*
†MISS GRACE A. FOOTE, B.A. ..... *Clerk and Stenographer.*
‡MISS MARTHA DE BUSSY ..... *Clerk and Stenographer.*

H. W. COLEY, Westport
A. W. YATES, Hartford } ..... *Apiary Inspectors.*

* Resigned March 1, to accept a position in the Bureau of Entomology.
** On leave of absence from July 1, to enter U. S. Military Service.
† Resigned August 10.
‡ Beginning August 26.

A few changes have taken place in the staff during the year. After five years of satisfactory and efficient service as assistant, Mr. Quincy S. Lowry resigned to take effect March 1, to accept a position with increased salary as extension entomologist in truck crop insects in the Bureau of Entomology, U. S. Department of Agriculture. Mr. Lowry has been assigned to the state of Massachusetts with headquarters at Amherst.

Mr. Irving W. Davis at his own request was granted a leave of absence from July 1, in order to enter the military service of his country. He has since enlisted in the Marine Corps. During his absence the gipsy moth work will be in charge of Mr. John T. Ashworth. Mr. Ashworth has worked as an assistant to Mr. Davis since June 1, 1917, and is thoroughly familiar with all phases of the work.

Miss Grace A. Foote, who has served faithfully and efficiently as clerk and stenographer for more than three years, resigned August 10, to accept another position with increased salary. Her place has been filled by the appointment of Miss Martha de Bussy, who entered upon her duties August 26.

Messrs. Walden and Zappe have continued as assistants and have both aided in the general work of the department and in inspecting nursery stock. Mr. Walden has devoted a portion of his time (4 months) to supervising the mosquito maintenance work as deputy to the Director, and during this time his salary was paid from the Station funds or from the appropriation for mosquito control work. Mr. Walden has also done most of the photographic work of the department. Mr. Zappe has followed out the life cycle of the semi-tropical cockroach *Pycnoscelus surinamenses* Linn, in the laboratory, and has been in charge of field spraying experiments to control potato and apple insects. The first half of April he was assigned to scouting for the Oriental Peach Moth, *Laspeyresia molesta* Busck, in the southeastern part of the state with Mr. E. D. Brown of the Bureau of Entomolgy.

From July 8 to September 21, Mr. Kenyon F. Chamberlain of Cornwall was employed as assistant and helped inspect the nurseries, and also aided in spraying and in photographing insects.

Messrs. H. W. Coley and A. W. Yates as in preceding years have made the apiary inspections on a *per diem* basis.

All members of the staff, and others mentioned above have worked faithfully, conscientiously and efficiently and their services are appreciated.

New Equipment.

A "model 90, Overland" touring car was purchased October 1st, 1917, for the general use of the department with a considerable saving in time and money, in travelling about the state.

In the gipsy moth work, a used "Buick light six" touring car was purchased in the spring. A new auto truck power sprayer was also purchased and proved very necessary and effective in the control of the gipsy moth.

Chief Lines of Work.

The required work of inspecting nurseries, imported nursery stock, apiaries, and suppressing the gipsy and brown-tail moths has been carried along in the usual manner and is described in the pages of this report.

Some attention has also been paid, chiefly by Mr. Walden, to the question of mosquito elimination. Mr. Zappe and the Entomologist have continued observations on the insects attacking squashes, pumpkins, melons and cucumbers in Connecticut and have experimented with various methods and applications for their control.

The outbreak of the potato aphid, *Macrosiphum solanifolii* Ashm. required considerable attention and spraying tests were conducted at the Station farm at Mt. Carmel to control the pest. The Entomologist has also made observations on potato insects for a number of years and a paper embodying these has just been published as Bulletin No. 208 of this Station.

Mr. Zappe has continued his studies and observations on a species of sawfly attacking Austrian pine and has also found time for laboratory studies on the development of the cockroach *Pycnoscelus surinamensis* Linn which was found last year causing much injury in one of the large commercial greenhouses of the state.

On account of the conditions caused by the war the production of food has been of prime importance and war gardens have been planted and cultivated in every town and city in the State. Though the larger cities have garden supervisors, and the Bureau of Entomology has furnished an extension entomologist in the person of Mr. George M. Codding, for work in Connecticut, many demands have

been made on the entomologist for advice and instruction about dealing with the insect pest of these gardens.

The requests come by telephone, by mail and through personal conferences with the workers. It has ever been the policy of this department and of the Station to render the greatest amount of service possible either directly, or through co-operation with other agencies. The department therefore has been in direct contact with many owners, with most of the paid supervisors, and with the Farm Bureau and other extension workers. Co-operating with Mr. Codding, the department supplied a portion of the exhibit on war gardens shown at Charter Oak and Berlin fairs as a part of the exhibit of the State Council of Defense.

This department has also co-operated with the Bureau of Entomology in searching for the possible occurrence of the Oriental Peach Moth, *Laspeyresia molesta* Busck and was asked to recommend a man who could be employed by the Bureau for scouting work. After a long search Mr. E. D. Brown of Clinton was obtained, and began work April 1st, 1918. Mr. Zappe worked with him for the first ten days with the automobile to get the work started aright. Until after October 1st, Mr. Brown worked in the state, finding evidences of this pest along the coast. He was then sent into Rhode Island and Massachusetts, but while in Connecticut, he reported to this office regularly and his itinerary was in a large measure directed by the Entomologist.

After Mr. Lowry resigned, on account of the scarcity of men and their need in military service it was decided not to fill his place at once but to try and do the necessary work with the reduced force. Hence it has been impossible to carry on the usual or the desired amount of investigation. Some time has been given to the papers prepared for the State Geological and Natural History Survey, which will not be published until after the war ends. Considerable work has also been done on the insect collection and in indexing in the department library.

Since March the Entomologist has served as Chairman of the Committee on Food of the New Haven War Bureau.

The following pages give detailed accounts of the principal activities of the department for the year.

ISPECTION OF NURSERIES.

The work of inspecting the growing nursery stock of Connecticut was commenced on August 13th and finished on October 16th. Most of the work was done by Messrs. M. P. Zappe, B. H. Walden and K. F. Chamberlain, but they were assisted by Mr. E. D. Brown of the Bureau of Entomology who was scouting for the Oriental Peach Moth *Laspeyresia molesta* Busck, and by W. E. Britton. Mr. George E. Graham of the Botanical Department worked one day in one of the large nurseries on the lookout for pine blister rust, and Mr. A. A. Saunders of the blister rust inspection service examined all the currants in another large nursery.

The Overland touring car was used to transport the men and was kept in constant use for over two months. Practically all of the 86 nurseries were reached in this way, and a considerable saving in time and railroad fares was affected.

The nurseries were given thorough inspection and all trees, shrubs and plants found infested with important pests, were marked. The owner or manager was informed regarding them and carried out directions about the proper treatment or destruction of the infested plants in order to free the nursery from these pests. In no case was a certificate granted until these directions had been carried out.

In 32 nurseries no pests were found. The following pests were each found in the number of nurseries indicated:

Insects; oyster-shell scale 39; San José scale 18; scurfy scale 9; pine leaf scale 7; elm scale 2; spruce gall aphid 15; pine weevils 5; apple aphids, ash borer, linden borer, lilac borer, white elm scale, rose scale and imported European sawfly, one each.

Plant diseases; poplar canker 6; chestnut blight, blister rust on currants, and fire blight, one each.

Of course certain common insects such as aphids, fall webworm, yellow-necked caterpillars, white-marked tussock moth, red-humped caterpillars, etc., are found nearly everywhere and nurseries are no exception. These were not, therefore, taken into account, except in severe infestations.

Attention should here be called to the great prevalence, both in 1917 and 1918 of the oyster-shell scale *Lepidosaphes ulmi* Linn. In fact for the past three years this has been recorded in a greater number of nurseries than has the San José scale *Aspidiotus pernici-*

ciosus Comst., which is now on the wane even as a pest of nursery stock. But the oyster-shell scale heads the list of pests, and though easy to control where attention is given it, is of serious importance on stock that is allowed to shift for itself. Consequently much stock had to be destroyed, and more pruned back to remove the infestation.

The poplar leaf beetles *Lina scripta* Fabr. and *L. lapponica* Linn. were not noticed at all, though quite abundant in three nurseries in 1917. The tulip tree scale *Toumeyella liriodendri* Gmel. also was conspicuous by its absence in 1918, though it was reported from six nurseries in 1915, from one in 1916, and from four in 1917. The Oriental peach moth *Laspeyresia molesta* Busck was not found in any nursery. The pine blister rust was found only in one nursery and that in the aecial and telial forms on the topmost leaves of red currants.

Besides these regular nursery inspections, a number of separate parcels have been examined and certified so that they could be shipped. In some cases the certificates were issued to persons not in the nursery business who wished to send trees or shrubs to their friends, and such shipments would not be accepted by common carriers unless accompanied by official certificates of inspection because most states require it. Some such certificates have been issued to nurserymen so that they might ship before their nursery was put in shape to receive the general certificate covering all the stock. During the year 13 such parcel certificates have been issued.

Two nurseries did not succeed in cleaning up in season to receive their certificates last year. Consequently their names did not appear on the published list. These were inspected in the spring and certificates issued, and were again inspected with the other nurseries in the Fall. Therefore 88 nursery inspections have been made and 87 regular certificates granted.

Of the 85 names on the nurserymen's list for 1918, three are new, and the list contains two more names than the list of last year. Three of the old firms have gone out of the nursery business, but the number is kept good by those who failed to make the list last year.

The area devoted to nursery stock has not changed greatly from last year though on account of the shortage of labor and the necessity of growing food, has been curtailed somewhat. It amounts to about 1,556 acres.

The list for 1918, together with location, acreage, date and number of certificate of each is given below:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1918.

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Barnes Bros. Nursery Co	Yalesville	150	Sept. 5	907
Beattie, Wm. H	New Haven	1	Feb. 18	981
Bertolf Bros	Sound Beach	25	Oct. 10	942
Bowditch, J. H	Pomfret Centre	8	Aug. 29	899
Brainard Nursery & Seed Co	Thompsonville	6	Oct. 1	925
Braley & Co	Burnside	1	Aug. 29	900
Bretschneider, A	Danielson	1	Sept. 7	908
Brooks Bros	Westbrook	1	Sept. 20	916
Burr & Co., C. R	Manchester	500	Sept. 23	919
Burroughs, Thos. E	Deep River	3	Sept. 20	914
Chapman, C. B	Groton	1	Sept. 4	902
Chapman, C. E	North Stonington	4	Aug. 28	898
Conine Nursery Co., The F. E	Stratford	50	Oct. 3	928
Conley, L. D	Ridgefield	3	Oct. 14	945
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	2	Oct. 31	961
Conn. Agri. Experiment Station (W. O. Filley, State Forester)	New Haven	1	Sept. 19	912
Conway, W. B	New Haven	1	Dec. 9	979
Crofut & Knapp Farm	Norwalk	60	Nov. 14	969
Cross Highway Nurseries	Westport	6	Oct. 18	952
Dallas, Inc., Alexander	Waterbury	3	Nov. 19	971
Dowd, Frank C	Madison	3	Oct. 31	962
Elm City Nursery Co., Woodmont Nurseries, Inc	Woodmont & New Haven	155	Sept. 23	917
Fairfield Landscape & Nurseries Co	Cannon Station	5	Oct. 18	951
Gardner's Nurseries	Cromwell	10	Dec. 6	977
Geduldig, G., Estate of	Norwich	1	Oct. 9	939
Goodwin Associates, Inc., The James L	Hartford	1	Nov. 9	966
Hartford Park Commissioners (G. A. Parker, Supt.)	Hartford	1	Oct. 30	958
Heath & Co	Manchester	5	Sept. 26	923
Hilliard, H. J	Sound View	1	Oct. 9	941
Holcomb, Irving	Simsbury	1	Sept. 4	901
Horan & Son, Jas	Bridgeport	1	Oct. 3	929
Houston & Sons, J. R	Mansfield	4	Nov. 12	968
Hoyt's Sons Co., Inc., The Stephen	New Canaan	300	Nov. 15	970
Hubbard & Co., Paul M	Bristol	12	Nov. 7	965

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1918—*Cont'd.*

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Hunt & Co., W. W	Hartford	12	Oct. 4	932
Intravaia, Joseph (2)	Middletown	1	Oct. 1	927
Isselee, Charles	Darien	3	Oct. 29	957
Kelley, James	New Canaan	1	Sept. 13	909
Kellner, Herman H	Danbury	1	Oct. 14	944
Larkin Bros., The	New London	1	Sept. 23	918
Long, J. A	East Haven	1	Nov. 19	972
Mallett Co., George A	Bridgeport	1	Dec. 6	978
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Oct. 9	940
Marigold Farm (H. Kelly, Prop.)	New Canaan	1	Sept. 13	910
McDermott, E. F	Windsor	1	Nov. 1	963
Meier & Gillette	West Hartford	2	Nov. 4	964
Millane Tree Expert Co., The	Middletown	1	Oct. 4	934
Munro, Charles	New Haven	1	Oct. 7	935
New Haven Nurseries	New Haven	10	Oct. 29	956
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Nov. 25	974
New London Cemetery Association (F. S. Newcomb, Pres.)	New London	1	Sept. 19	913
New London County Nurseries (W. J. Schoonman, Prop.)	New London	5	May 18	897
North-Eastern Forestry Co	Cheshire	20	Sept. 5	906
Norwich Nurseries (O. E. Ryther Prop.)	Norwich	6	Dec. 3	975
Oakland Nurseries	Manchester	5	Sept. 26	924
Palmer, L. M., Estate of	Stamford	5	Oct. 7	936
Park Gardens	Bridgeport	1	Oct. 3	931
Pequod Nursery Co	Meriden	15	Sept. 26	921
Phelps, J. Wesson	Bolton	1	Sept. 26	920
Phelps & V. T. Hammer Co., The J. W	Branford	2	Oct. 22	953
Pierson, A. N., Inc	Cromwell	35	Sept. 5	904
Platt Co., The Frank S	New Haven	1	Oct. 7	937
Pomeroy, Edwin C	Northville	1	Oct. 14	946
Purington, Mrs. C. O	Hartford	1	Oct. 9	938
Quality Seed Store	Stamford	1	Oct. 11	943
Raab, Joseph O	Ansonia	1	Oct. 25	955
Reck, Julius	Bridgeport	1	Oct. 3	930
Roehrich, W. G	Stratford	1	Sept. 20	915
Saxe & Floto	Waterbury	1	Nov. 23	973
Schleichert, F. C	Bridgeport (2)	1	Dec. 5	976
Scott, J. W	Hartford	5	Nov. 9	967
Sierman, C. H	Hartford	5	Oct. 4	933
South Wilton Nurseries	South Wilton	5	Sept. 5	903
Steck, Charles A	Bethel	1	Oct. 23	954

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1918—*Conc'd.*

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Stratfield Nursery Co	Bridgeport	4	Dec. 30	980
Traendly & Schenck	Rowayton	2	Oct. 15	948
Upson, R. E	Marion	1	Oct. 31	960
Verkade, H	New London	1	Sept. 17	911
Vidbourne & Co., J	Hartford	7	Oct. 1	926
Wallace, Arthur T	Wallingford	2	Oct. 14	947
Wallingford Nurseries	Wallingford	10	Sept. 26	922
Wild, Henry	Riverside	2	Oct. 15	949
Wilson & Co., C. E	Manchester	10	Sept. 5	905
Yale University Forest School	New Haven	1	Oct. 15	950
Young, Mrs. Nellie A	Pine Orchard	1	Oct. 30	959
Total acreage		1556		

INSPECTION OF IMPORTED NURSERY STOCK.

As in 1917, less nursery stock was received in Connecticut in 1918 than during the preceding year. This is due, of course, to the conditions brought about by the war in Europe. There is a scarcity of labor for growing the stock especially in France and England where all available labor is directed toward the production of food or munitions. As Belgium has been occupied by German troops and many laborers deported, it is fair to assume that in Belgium, also little attention has been given to the growing of nursery stock though the exact conditions there are not known to us. In Holland, too, the war has necessitated many economic changes. It is reported that a large portion of the army has been kept mobilized. Many refugees and interned soldiers have been fed, and much relief work has been done. The growing of bulbs and nursery stock has long been an important industry in Holland, and though without doubt it is still important, it is inconceivable that it should not be seriously affected and curtailed by the war.

The shipping facilities, also have not favored the importation of foreign nursery stock into the United States. Consequently the total number of both shipments and plants brought into Connecticut has been less than half that of 1917, and shows a still greater decrease if compared with the figures for 1916. These records for the three seasons are given in the table below.

Year	Shipments	Cases	Plants
1916	291	2,102	1,998,178
1917	163	682	1,706,977
1918	73	387	830,035

Of the plants received in 1918, a large proportion consisted of Manetti rose and seedling fruit stocks.

The shipments have entered the Country under the system of permits and notices adopted a few years ago by the Federal Horticultural Board. This system is still in force, and the inspections have nearly all been made by State men at destination points within the State. Most of the inspection work was done by Messrs. Lowry and Zappe but Messrs. Davis, Walden and Britton assisted during the rush seasons. The total time necessary to make these inspections amounted to 58 days of 7½ hours each, or more than one-sixth the working time of one man for a year. The cost of this work including time and travelling expenses has amounted to about $418.87 or about two-thirds that of the preceding year, and has been paid on duly accredited vouchers by order of the State Comptroller from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock.

The sources of this stock are given in the following table:

SOURCES OF IMPORTED NURSERY STOCK, 1917-1918.

Country	No. of Shipments	No. of Cases
Holland	33	223
France	19	97
England	13	43
Scotland	3	3
Ireland	2	2
Japan	2	17
Unknown	1	2
Total	73	387

It will be noted that none of this stock came directly from Belgium, Italy or Germany. Belgium has heretofore been a prolific source of such stock and even last year there were 56 shipments containing 234 cases, brought into Connecticut from Belgium. There has never been much nursery stock brought into Connecticut from Italy or Germany and the last shipments to arrive from each of these Countries were in the season of 1914-1915.

As three shipments were sent into other states, two refused and 73 inspected, a total of 78 shipments were reported to the Federal Horticultural Board.

Of the 73 shipments inspected, 21 shipments or 28.7 per cent. were found infested with insects or fungi some of which are pests. None, however, are known to be important pests not already found in this country. One of the most notable is the Boxwood Leaf-

Miner or Leaf Midge, *Monarthropalpus buxi* Lab. which was found in one shipment from Gouda, Holland, and in another shipment from Surrey, England. Though this appears to be the first definite record for Connecticut, the insect has been reported from Rhode Island, Philadelphia, Pa., Long Island and Westchester County, N. Y., and may at any time be found here.

Some of the insect pests found were identified in this department and some of the fungi were determined by Dr. G. P. Clinton, Botanist of this Station. Other insects and plant diseases were identified by the Bureaus of Entomology and Plant Industry respectively of the U. S. Department of Agriculture, Washington, D. C.

Details regarding the infestations are given in the following list:

PESTS FOUND ON IMPORTED NURSERY STOCK, 1917-18.

21 Shipments Infested.

Insects, Etc.

Acronycta (?) sp. cocoon on Rose stock. Levavasseur & Sons, Ussy, France.

Alphitophagus bifasciatus Say. Rose stock. Stuart Low & Co., Enfield, England.

Anisodactylus binotatus Fabr. (2) Evergreens. Walter C. Slocock, Surrey, England.

Anisodactylus binotatus Fabr. (1) On moss around roses. Hugh Dickson, Ltd., Belfast, Ireland.

Centipedes on Rose stock. Louis Leroy Nurseries Co., Angers, France.

Chionaspis salicis L. On cross piece of packing box. Thos. Smith & Sons, Troon, Scotland.

Diprion cocoon, parasitized. On Rose stock. Louis Leroy Nurseries Co., Angers, France.

Diprion cocoon (probably *simile*), on Rose stock. Vincent Lebreton's Nurseries, La Pyramide-Trelaze, France.

Emphytus cinctus on Fruit Tree Stocks. E. Turbat & Co., Orleans, France.

Emphytus cinctus on Rose stock.

S. Bide & Sons, Ltd., Surrey, England; Franco-American Seedling Co., Angers, France; Franco-American Seedling Co., Nantes, France; M. Gielen, Oudenbosch, Holland; Levavasseur & Sons, Ussy, France; Louis Leroy Nurseries Co., Angers, France.

Leaf Miner on Boxwood. A. Koloos & Co., Gouda, Holland; Walter C. Slocock, Surrey, England.

Othius fulvipennis Fabr. Evergreens. Walter C. Slocock, Surrey, England.

Oyster-shell Scale on Boxwood. Ebbinge & Van Groos, Boskoop, Holland; W. Van Kleef & Sons, Boskoop, Holland.

Pontia rapae Linn. pupa on Rose stock. Vincent Lebreton's Nurseries, La Pyramide-Trelaze, France.

Soft Scale on Boxwood. Schaum & Van Tol, Boskoop, Holland.

Spider on rose stock. Louis Leroy Nurseries Co., Angers, France.

Spider's eggs on Holland plants. As. Ouwerkerk, Boskoop, Holland.
Staphylinid Beetle on Rose stock. F. J. Grootendorst & Sons, Boskoop, Holland.
Stenolophus skrimshiranus Schrank. Evergreens, Walter C. Slocock, Surrey, England.
Woolly Aphis on Apple Roots. Franco-American Seedling Co., Angers, France.
Coleopterous larva in soil around Rhododendrons. Harry Koolbergen, Boskoop, Holland.

Plant Diseases.

Crown gall on Rose stock. Levavasseur & Sons, Ussy, France; Vincent Lebreton's Nurseries, La Pyramide-Trelaze, France.
Immature fungus, possibly *Phyllosticta* sp. on Rhododendron. Vincent Lebreton's Nurseries, La Pyramide-Trelaze, France.

INSPECTION OF APIARIES.

The inspection of apiaries has been carried out as in preceding years. The work is directed by the State Entomologist, and the inspections have been made by H. W. Coley of Westport, and A. W. Yates of Hartford, on a *per diem* basis. Mr. Coley covers the four southern counties, Fairfield, New Haven, Middlesex and New London, and Mr. Yates the four northern counties, Litchfield, Hartford, Tolland and Windham.

On account of the severe winter many colonies, and in some cases entire apiaries, died. The number of colonies per apiary is therefore less than usual.

During the season, 385 apiaries, containing 2,913 colonies were inspected: in 1917 the record was 473 apiaries and 4,506 colonies. Eighty-three towns were visited as against 84 last year.

Though the number of apiaries and number of colonies inspected are less than last year, the percentage of infestation with European foul brood was considerably smaller.

In 1918, visits were made to the following towns not visited in 1917: Monroe, Wallingford, East Lyme, Bridgewater, Colebrook, Cornwall, Goshen, Litchfield, Norfolk, North Canaan, Salisbury, Sharon, Winchester, East Granby, Enfield, Suffield, Windsor Locks, Columbia, Somers, Stafford, Willington, Ashford, Chaplin, Canterbury and Scotland. All other towns where inspection, were made were visited in 1917. No inspections were made in the following towns which were visited in 1917: Bridgeport, Branford, Cheshire, Guilford, Hamden, Meriden, North Branford, Wolcott, Durham, Middletown, Portland, Lisbon, Roxbury, Thomaston, Woodbury, East Hartford, Glastonbury, Manchester, Southington, West Hart-

ford, Andover, Bolton, Brooklyn, Putnam, Windham, and Woodstock.

Apiaries were inspected for the first time in the towns of Bridgewater, Chaplin, Clinton, Columbia and Cornwall.

No inspections were made in 1918, in Middlesex County, but in all the other seven counties European foul brood was found and in the following towns: Easton, Greenwich, New Canaan, Ridgefield, Stamford, Ansonia, Derby, Madison, Prospect, Wallingford, East Lyme, New London, Old Lyme, Waterford, Bridgewater, New Hartford, Plymouth, Winchester, Bloomfield, East Granby, New Britain, Plainville, Windsor Locks, Coventry, Mansfield, Vernon and Sterling.

American foul brood was found in 1918 in Fairfield, New Haven and New London Counties and in the towns of Greenwich, Stamford, Madison, Waterford and Norwich. This disease seems to occur chiefly in the southern half of the state.

The statistics of the apiaries inspected in each of the 83 towns, in each of the seven counties in 1918, are given in the following tables, the summary occuring on page .

APIARIES INSPECTED, 1918.

Town FAIRFIELD COUNTY.	No. Apiaries Inspected	No. Apiaries Diseased*	No. Colonies Inspected	No. Colonies Diseased*
Bethel	9	0	41	0
Danbury	1	0	21	0
Darien	2	1	42	2
Easton	2	0	81	0
Fairfield	6	0	80	0
Greenwich	13	5	87	7‡
Huntington	2	0	82	0
Monroe	5	0	70	0
New Canaan	6	2	38	2
Norwalk	8	0	92	0
Redding	5	0	48	0
Ridgefield	9	2	59	2
Stamford	13	5	125	14§
Stratford	2	0	74	0
Trumbull	1	0	68	0
Westport-Weston	8	0	73	0
Wilton	3	0	11	0
Total	95	15	1092	27

* European foul brood unless otherwise indicated.

‡ One with American foul brood.

§ Ten with European, two with American foul brood; one with sacbrood; one with bee paralysis.

NEW HAVEN COUNTY.				
Ansonia	1	1	16	2
Beacon Falls	1	0	18	0
Derby	5	1	63	2
Madison	3	1	24	4†
				6
Middlebury	2	0	25	0
Milford	2	0	69	0
Naugatuck	3	0	30	0
North Haven	4	0	32	0
Prospect	8	2	40	2
Seymour	2	0	41	0
Wallingford	6	1	49	2
Waterbury	4	0	18	0
Total	41	6	425	18
NEW LONDON COUNTY.				
East Lyme	2	2	37	5
Montville	6	0	41	0
New London	2	1	38	2
Norwich	6	1	135	1†
Old Lyme	2	1	42	2
Waterford	7	1	50	35¶
Total	25	6	343	45
LITCHFIELD COUNTY.				
Bridgewater	4	2	24	4
Colebrook	1	0	1	0
Cornwall	3	0	22	0
Goshen	2	0	1	0
Kent	8	0	47	0
Litchfield	5	0	26	0
New Hartford	2	1	26	1
New Milford	11	0	90	0
Norfolk	6	0	11	0
New Canaan	8	0	65	0
Plymouth	2	1	8	1
Salisbury	9	0	46	0
Sharon	11	0	56	0
Watertown	1	0	5	0
Winchester	10	1	49	1
Total	83	5	477	7

† All American foul brood.

¶ Five with American foul brood.

HARTFORD COUNTY.

Berlin	14	0	45	0
Bloomfield	7	1	158	1
Bristol	5	0	15	0
Burlington	4	0	21	0
Canton	1	0	16	0
East Granby	4	2	13	2
East Windsor	14	0	54	0
Enfield	4	0	11	0
Farmington	2	0	8	0
Hartford	7	0	59	0
New Britain	1	1	3	1
Newington	1	0	3	0
Plainville	4	1	12	1
South Windsor	6	0	10	0
Suffield	4	0	7	0
Windsor Locks	1	1	4	4
Total	79	6	439	9

TOLLAND COUNTY.

Columbia	2	0	2	0
Coventry	7	2	39	3
Ellington	8	0	28	0
Mansfield	6	1	38	3
Somers	8	0	17	0
Stafford	1	0	5	0
Vernon	6	1	23	1
Willington	8	0	21	0
Total	46	4	173	7

WINDHAM COUNTY.

Ashford	1	0	5	0
Canterbury	2	0	7	0
Chaplin	2	0	15	0
Killingly	3	0	3	0
Plainfield	5	0	13	0
Pomfret	1	0	12	0
Scotland	1	0	20	0
Sterling	5	1	12	1
Windham	6	1	11	0
Total	26	2	98	1

SUMMARY.

County	No. of Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased
Hartford	16	79	6	439	9
Tolland	8	46	4	173	7
Fairfield	17	95	15	1,092	27
New Haven	12	41	6	425	18
Litchfield	15	83	5	477	7
New London	6	25	6	343	45
Windham	9	26	2	98	1
Middlesex	0	0	0	0	0
Total	83	395	44	3,047	114

	Apiaries	Colonies
Number inspected	395	3,047
Infested European foul brood	39	99
Per cent. infested	9.8	3.3
Infested American foul brood	4	10
Per cent. infested	1.01	.32
Pickled or sacbrood	1	1
Bee paralysis	1	1
Average number of colonies per apiary		7.8
Cost of inspection		$780.32
Average cost per apiary		1.97
Average cost per colony		.25

Records of European Foul Brood in Connecticut.

In discussing the subject of European foul brood with a bee-keeper, I remarked that the disease had probably been found in every town in the state. Afterward I wondered if this were true. Then we looked up the records, and this paper is the result.

It should be borne in mind that the appropriation for inspecting apiaries has never been sufficient to cover the cost of inspecting all apiaries each year. A small proportion only can be examined. There has been an attempt, however, to cover a somewhat different section each year in order to become familiar with the apiary conditions in the whole state. Nevertheless there are a few towns in which inspections have never been made. These are as follows: New Fairfield and Sherman, Fairfield County; East Haven and Oxford, New Haven County; Chester, Essex, Middlefield, Old Saybrook, Saybrook, and Westbrook, Middlesex County; Franklin, Lebanon, Preston and Voluntown, New London County; Washington and Warren, Litchfield County; Avon, Hartford County; Union, Tolland County; Eastford, Windham County.

Just what territory should be covered in any year, is determined largely by the inspectors, themselves, after consulting with the State Entomologist. There are always places that need visiting on account of disease conditions the preceding year. There are also many requests from beekeepers that their apiaries be examined. It is good practice, I believe, to pay special attention to the more important beekeeping centers where the industry as a whole can be most markedly benefited by the inspection work.

The following records show the names of towns in which inspections have been made during the nine years since the inspection law went into effect; that no European foul brood has ever been found by the inspectors in the towns of Brookfield and Trumbull, Fairfield County; Bethany, North Branford, North Haven, Orange, and Woodbridge, New Haven County; Clinton, Middlesex County; Groton, Ledyard, Lyme and Sprague, New London County; Canaan, Cornwall, Goshen, Morris, Roxbury, Salisbury and Woodbury, Litchfield County; Simsbury, Hartford County; Columbia, Ellington and Somers, Tolland County; Ashford, Canterbury and Chaplin, Windham County. This does not mean that the disease has never occurred in these towns.

European foul brood has been found in many towns as the following tables will show. These towns are arranged alphabetically by counties, and after the name of each town is given the year that the disease was found.

FAIRFIELD COUNTY.

Town	Year
Bethel	'10, '14, '15, '16, '17.
Bridgeport	'10, '11.
Danbury	'10, '13, '14, '15 '16.
Darien	'11, '14, '18.
Easton	'10, '11, '14.
Fairfield	'10, '11, '13, '14, '15, '17.
Greenwich	'11, '12, '18.
Huntington	'11, '17.
Monroe	'16.
New Canaan	'10, '14, '15, '17, '18.
Newtown	'16.
Norwalk	'10, '13, '17.
Redding	'10, '11.
Ridgefield	'10, '11, '14, '15, '16, '17, '18.
Stamford	'11, '12, '13, '15, '17, '18.
Stratford	'11, '13, '15.
Weston	'13, '17.
Westport	'10, '12, '13, 14, '15, '17.
Wilton	'10, '11, '14, '16.

NEW HAVEN COUNTY.

Town	Year
Ansonia	'16.
Beacon Falls	'12, '13, '14.
Branford	'12.
Cheshire	'15.
Derby	'10, '11, '13, '14, '15, '18.
Guilford	'16.
Hamden	'14, '15.
Madison	'15, '16, '17, '18.
Meriden	'12, '13, '16.
Middlebury	'15, '16, '17.
Milford	'12, '14.

Naugatuck '17.
New Haven '16.
Prospect '13, '16, '18.
Seymour '10, '11, '14.
Southbury '11, '16.
Wallingford '18.
Waterbury '17.
Wolcott '16, '17.

MIDDLESEX COUNTY.

Town	Year
Cromwell	'10, '12.
Durham	'10.
East Haddam	'10, '14, '16.
East Hampton	'12, '13, '14, '15.
Haddam	'14.
Killingworth	'14.
Middletown	'10, '15.
Old Lyme	'12, '15, '18.
Portland	'12.

NEW LONDON COUNTY.

Town	Year
Bozrah	'16.
Colchester	'12, '14, '15.
East Lyme	'17, '18.
Griswold	'12.
Lisbon	'12, '14, '15, '16, '17
Montville	'14, '15, '16, '17.
New London	'12, '15, '16, '17, '18.
North Stonington	'15.
Norwich	'12, '13, '14, '15, '17.
Salem	'16.
Stonington	'12, '15.
Waterford	'15, '16, '17, '18.

LITCHFIELD COUNTY.

Town	Year
Barkhamsted	'12, '13, '15.
Bethlehem	'15.
Bridgewater	'18.
Colebrook	'15.
Harwinton	'14.
Kent	'16.
Litchfield	'11, '12, '13.
New Hartford	'15, '18.
New Milford	'17.
Norfolk	'16.
North Canaan	'16.
Plymouth	'14, '15, '16, '17, '18.
Sharon	'12.
Thomaston	'13, '14, '15.
Torrington	'12, '14, '15, '16.
Watertown	'14, '15.
Winchester	'12, '13, '14, '15.

HARTFORD COUNTY.

Town	Year
Berlin	'14, '15.
Bloomfield	'11, '12 '13, '16, '17, '18.
Bristol	'14, '15, '16, '17.
Burlington	'13, '14.
Canton	'13, '14, '15.
East Granby	'14, '15, '18.
East Hartford	'14.
East Windsor	'14, '17.
Enfield	'11, '14, '15.
Farmington	'10, '12, '13, '14, '15, '17.
Glastonbury	'14, '15, '16.
Granby	'14.
Hartford	'10, '11, '14.
Hartland	'15.
Manchester	'10, '12, '13, '14, '15, '17.
Marlboro	'12.
New Britain	'14, '15, '17, '18.
Newington	'10.
Plainville	'14, '15, '16, '17, '18.
Rocky Hill	'11, '14.
Southington	'14, '17.
South Windsor	'12, '14, '15.
Suffield	'14.
West Hartford	'10, '11, '12, '13, '14, '16.
Westersfield	'10, '11, '13, '15, '17.
Windsor	'10.
Windsor Locks	'11, '15, '18.

TOLLAND COUNTY.

Town	Year
Andover	'15, '16.
Bolton	'13.
Coventry	'13, '15, '16, '17, '18.
Hebron	'12.
Mansfield	'16, '18.
Stafford	'14, '16.
Tolland	'16.

Vernon '11, '13, '14.
Willington '11, '16.

WINDHAM COUNTY.

Town Year
Brooklyn '14.
Killingly '15, '16.
Hampton '16.
Plainfield '16, '17.
Pomfret '10, '11, '13, '14, '15, '17.
Putnam '10, '11, '13, '15, '16, '17.
Scotland '12.
Sterling '17, '18.
Thompson '10, '11, 17.
Windham '12, '16, '17.
Woodstock '10, '11, '15.

During the first year of inspection work (1910) more than 75 per cent. of all apiaries visited had some trace of European foul brood. About half of all the colonies examined were affected with the disease. The proportions have decreased consecutively until the present (1918) only about 10 per cent. of the apiaries and 3.5 per cent. of the colonies inspected have European foul brood.

PERCENTAGES OF EUROPEAN FOUL BROOD IN APIARIES INSPECTED.

Year	Diseased: European Foul Brood	
	Apiaries, Per cent.	Colonies, Per cent.
1910	75.9	49.7
1911	51.8	27.4
1912	47.7	23.5
1913	44.4	24.5
1914	32.6	13.9
1915	26.1	10.3
1916	18.8	7.05
1917	16.7	4.86
1918	9.8	3.3

Records of American Foul Brood in Connecticut.

The present system of inspecting apiaries in Connecticut has been in vogue since the first inspection law was passed in 1909; the act did not take effect until October 1st, too late to do any work that season; consequently the first inspections were made early in the summer of 1910. Thus during nine years, a portion of the apiaries of the state have been inspected each year, the appropriation not being sufficient to inspect all apiaries annually, and permanent records are kept on 5 x 8 cards in my office. These are open to inspection during office hours.

Though European Foul Brood has been found each year, the first American Foul Brood was discovered in 1914, in the two towns of Bethlehem in Litchfield County, and Old Lyme in New London County.

In Bethlehem the disease was found in one apiary of three colonies; one colony was diseased and destroyed. No disease could be found in this apiary the following year (1915).

In Old Lyme the statistics are as follows:

One	apiary	containing	5	colonies	all	infested.
"	"	"	1	"	"	"
"	"	"	2	"	"	"
"	"	"	18	"	"	"

The first one of 5 colonies, had only one colony in 1915 and that was infested with American foul brood and European foul brood and was destroyed.

The next two were cleaned and we have no record of subsequent inspections.

In the fourth case one apiary in Old Lyme, had 18 colonies in 1914, and all were diseased with American foul brood. These were treated by Mr. Coley and when inspected on July 31 of the following year the apiary contained 45 colonies and no disease was found, though the owner had treated two colonies in the spring for American foul brood.

In 1916, two out of 45 colonies were found infested, and treated In 1917, out of 52 colonies in the apiary 6 were diseased with American foul brood. The owner agreed to treat them. In 1918 this apiary was inspected July 18, and two of the 35 colonies were found infested with European foul brood and destroyed. No American foul brood was found.

In 1915, two other apiaries in Old Lyme were found to contain American foul brood. One contained four colonies, two of which were infested. In 1916 no disease was found but in 1917, two colonies had American foul brood. In 1918, no disease was found. The other case was in an apiary of 12 colonies, four being diseased. This apiary has been inspected each year since and no disease was found.

In 1916, two apiaries in the town of Huntington contained American foul brood. Of seven colonies in one apiary, and 35 colonies in the other, one colony in each was diseased with American foul brood. In the former, this disease was not detected the following year (1917) and in the other, apparently no inspection has been made since.

One colony in an apiary of 38 in the town of Ridgefield was found diseased with American foul brood in 1916, and was destroyed. The entire apiary appeared healthy when inspected in 1918.

One colony in an apiary of 18 at East Hampton (formerly Chatham) was found diseased with American foul brood in 1916. The owner promised to give treatment but we have no subsequent record of the condition of the apiary.

In 1917, American foul brood was found only at Old Lyme in the cases which I have just described.

In 1918, however, it was found in one apiary in each of the towns of Greenwich, Stamford, Madison, Waterford, and Norwich. In Greenwich one apiary of four colonies, had one diseased; in Stamford, 45 colonies, two diseased; in Madison, 18 colonies, four diseased; in Waterford, 41 colonies, two diseased; in Norwich, 96 colonies, one diseased.

Thus it will be seen that American foul brood has been present in the following towns and counties in Connecticut:

County	Town	Year
Fairfield	Greenwich	1918
	Huntington	1916
	Ridgefield	1916
	Stamford	1918
New Haven	Madison	1918
Middlesex	East Hampton	1916
New London	Old Lyme	1914, 1915, 1916, 1917
	Waterford	1918
	Norwich	1918
Litchfield	Bethlehem	1914

Percentages of American foul brood infestation of the bees examined each year are given in the table below:

	Percentage of Infestation.	
Year	Apiaries	Colonies
1910	0	0
1911	0	0
1912	0	0
1913	0	0
1914	1.07	.7
1915	.8	.18
1916	1.07	.15
1917	.42	.17
1918	1.01	.32

SUPPRESSING THE GIPSY AND BROWN-TAIL MOTHS IN 1918.

By W. E. Britton, I. W. Davis and J. T. Ashworth.

Introduction.

This work has been conducted in about the same manner as in preceding years. Except that on account of the war, labor has become so scarce that it has been necessary to rely more upon spraying and to curtail somewhat the scouting operations. Where possible men have been employed throughout the year, either by the State or by the Federal forces. These men served as scouts during the scouting season and were all utilized on spraying work from May 17 to June 29.

As in former years this work has been carried on in co-operation with the Federal Bureau of Entomology. This co-operation has been most satisfactory and we wish to express our thanks to Mr. A. F. Burgess, in charge of the Federal work and Mr. L. H. Worthley who has had supervision of the field work. Both have shown every inclination to assist us in controlling the gipsy moth in Connecticut.

Since the publication of the report of the work done last year, seven new towns have been found slightly infested making in all 29 towns in the infested area. None of these are infested to a degree sufficient to cause noticeable injury to the foliage of trees, and most persons know that the gipsy moth is present only because they see the men at work in the scouting and spraying operations.

Men Entering the Service in 1918.

Mr. Davis was granted a leave of absence from July 1st, and enlisted in the U. S. Marine Corps for the duration of the war. Altogether 13 employees have entered the service, the following being in addition to the list printed in the report for 1917, page 247:

Irving W. Davis	Marine Corps
Arthur W. Bradley	Cavalry
Waldo P. Colvin	Limited Service
Richard Newton	Artillery
Raymond Smith	Brown University Officer's School

New Equipment.

On account of the expense and difficulty in obtaining teams to cart poison and hose during the spraying season, it was decided to use the Ford car for this purpose and a truck or "delivery" body was procured for it. This necessitated another machine for supervision and transporting men, and a used Buick six cylinder touring car was purchased in the spring. This car has been used on the work since with entire satisfaction.

Additional spraying equipment has been obtained in the purchase of an automobile truck power sprayer designed and constructed for spraying woodland trees. This machine has a carrying capacity of two and one-half tons, is fitted with a Continental four cylinder motor, a Fitzhenry-Guptill pump driven by the propelling motor, a 400 gallon tank, 36 inch solid tires with 4 inch face front, 6 inch rear. The pump and tank are readily removed and the truck used for general transportation purposes. This outfit is shown on plate XXII, a. Sixteen hundred feet of 1½ inch fire hose and 75 feet of suction hose were also purchased during the year.

Labor and Board.

On account of the shortage of labor, and particularly because of the need of men in military service and in making munitions, it is difficult to obtain and keep men in the field. As wages in munitions factories are very much higher than we have been paying, there is a temptation for the men to leave and go into the shops. In fact it is difficult at the best to obtain the right sort of men for scouts. They should be young men in good health or they are not able to walk long distances, climb trees, and be on their feet all day. Above all they must be reliable. They must have good habits, be dignified, and courteous to property owners and residents. They must have good eyes and always be on the alert. They must also have some judgment about handling an infestation.

The best men for such work are young men raised in the country, who live out of doors. Such men will hesitate and often refuse to go into factories even though greater wages may be obtained there. Consequently the men now employed are for the most part of this character. Nevertheless it has been necessary to increase wages somewhat above the amounts paid before the war. The policy has been to start a man on the minimum wage and to raise him as soon as he has acquired the proper experience and training if he shows

an adequate degree of interest, adaptability and efficiency in his work. Another great difficulty is in finding boarding places for the men. In some towns there are no hotels or boarding houses and it is impossible to find board in private families unless at a price that is prohibitive.

On account of this great difficulty of finding suitable boarding places, the men are often obliged to board in an adjoining town. To walk back and forth is too much to expect, especially when they are on their feet practically all day. Consequently we have adopted the practice of transporting the crews from their boarding place to their work, especially in the towns where board cannot be found near at hand. Each crew is taken out in the morning and brought back at night. For this purpose the motor cars are a necessity.

Spraying.

As has already been mentioned on account of the rather large area infested and the price and shortage of labor, it has seemed wise to curtail somewhat the scouting operations and to place more dependence upon spraying as a means of control. This change in policy requires additional apparatus, and as mentioned above a new automobile truck power sprayer was purchased for this work. The horse-drawn power sprayer is still in serviceable condition and was used and will continue to be used in the thickly infested towns like Thompson and Putnam where the infestations are not far apart. It would take several of these, however, to do all the spraying in the whole 29 towns, and where it is necessary to go ten or perhaps twenty miles from one infestation to another, much time is consumed *en route*. Moreover it is becoming increasingly difficult to hire horses and drivers for such outfits.

The auto truck sprayers, do not require horses, can be driven by qualified employees, will cover the distances at the rate of ten miles per hour, and in stormy weather do not incur expenses for board of team.

During 1918, we used two horse-drawn outfits and two automobile truck outfits one of each being furnished by the Federal authorities. The Federal men sprayed the infestations in the towns of Eastford, Windham, Hampton, Mansfield, Plainfield, Scotland, Griswold, Lisbon, Norwich, and Ledyard, and with their horse-drawn outfit helped spray the infestations in Thompson. The remaining work in Thompson and that done in Putnam, Woodstock,

Pomfret, Brooklyn, and Killingly was done by State forces. Altogether 392 separate colonies or infestations were treated by spraying. The Federal men operated their auto-truck sprayer, but the State furnished men for the Federal horse-drawn outfit.

New Towns Infested.

As in former years Federal men have scouted the towns along the outer margin of the infested area, and the State funds have been expended in the more thickly infested portion of the territory.

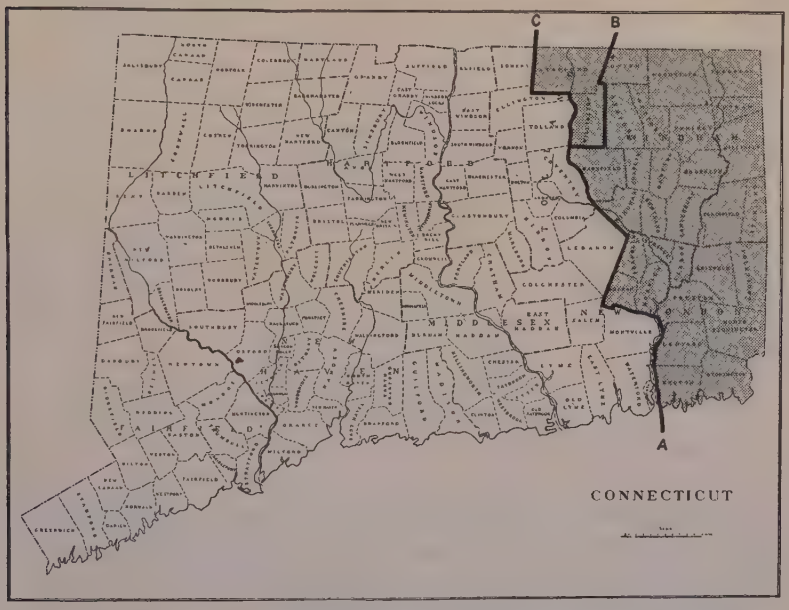


Figure 7. Map of Connecticut showing areas infested by gipsy and brown-tail moths. All territory east of the line A B is quarantined on account of the gipsy moth; territory east of the line A C is quarantined because of brown-tail moth.

As a result of scouting by the Federal men, seven additional towns were found to be slightly infested, namely, Union, Windham, Franklin, Bozrah, Norwich, Preston and Ledyard. The present infested area containing 29 towns, 617,124 acres or 964.25 square miles, is shown on the map, figure 7.

Parasites.

A full account of the parasites liberated and recovered in Connecticut was given in the Report of this Station for 1917, page 249.

There is little to be added here. Some of the parasites have been on the increase and no doubt have helped to check the pest. During 1918, in one section each of the towns of Putnam, Thompson and Plainfield the men observed *Calosoma* beetles devouring gipsy caterpillars. Three colonies of *Anastatus bifasciatus* Fonsc. were liberated in different sections of the town of Eastford.

During 1918, according to Mr. Burgess, the egg parasite, *Anastatus bifasciatus* Fonsc., was liberated in Connecticut towns as follows:

Town	No. of Colonies
Eastford	3
Putnam	31
Mansfield	1
Hampton	3
Brooklyn	3
Killingly	3
*Scotland	1
*Plainfield	4
*Sterling	2
*Griswold	2
*Voluntown	1
Total	54

This parasite was recovered in 1918 for the first time in Connecticut at Eastford.

Details of Gipsy Moth Work by Towns.

The following pages give a detailed account of the work done in each of the infested towns:

Thompson—275 Infestations—7,255 Egg-clusters.

As in preceding years, Thompson continues to be the most thickly infested town in the state. There were not as many large infestations, however, as we had reason to expect. There were many singles, which were creosoted and the trees marked, which were not counted as separate colonies as in preceding years. This is responsible for the reduction in the number of infestations from 518 in 1917 to 275 in 1918. Several large colonies of former years had evidently been entirely cleaned up. All available data point to a very successful spraying season in 1917.

* Liberated in these towns for the first time.

During the scouting of 1916-1917, the eastern portion of the town was covered first, and by the time the western part was reached, winter had arrived and the snow hindered greatly. Consequently the following year the western portion was covered first, and most of the town had been finished before winter really set in.

The Federal forces aided us by the loan of a complete spraying outfit, and with this help we were able to spray a total of 149 colonies in Thompson. The results of spraying last year in the Brandy Hill district, were apparent in the decrease in the number of infestations in 1917-18.

Owing to the early hatch and the lack of labor none of the trees were banded around the infestations in Thompson in 1918, although a number of woodland infestations were chopped and cleaned out and the brush burned during the preceding winter. After the spraying season was over, the men were sent around to the infestations, and the conditions as regards larvae were carefully noted at both sprayed and unsprayed colonies. All larvae found were destroyed and all colonies showing larvae were visited every two or three days until the men took their vacation the first of August.

Some of the woodland regions have already been examined this Fall and no large infestations have been found.

Woodstock—16 infestations—1,057 egg-clusters.

Last year Woodstock was scouted only as far west as the road marked D on our blue print map thus covering about two-thirds of the town—the eastern portion, including the villages of East Woodstock, West Woodstock, North Woodstock, South Woodstock, and Woodstock Hill. The remainder or western third consisting mostly of wooded area was not finished on account of a shortage of labor and the early hatching of the eggs (May 2d). As in the preceding year South Woodstock was the most thickly infested portion, although there were colonies scattered over the entire eastern part of the town. The largest infestation, 116 egg-clusters was located on land owned by Mr. Frank Tripp.

As was the case in Thompson no banding of trees was done, but 30 of the largest infestations were sprayed with lead arsenate. After the spraying season was over the men visited these infestations and succeeded in finding only nine larvae, which they destroyed.

Owing to its large area, abundance of apple trees, and the difficulty of obtaining board for the men the town of Woodstock has always been difficult to cover in the scouting work. The western portion of the town not covered last year has just been gone over this fall and several infestations found in the southern portion. As in Thompson single egg-clusters were not counted as infestations.

Putnam—98 infestations—2,787 egg-clusters.

This is also a part of the thickly infested area of the State. Several large colonies were found but with few exceptions these were in the woodland. The exceptions were old apple orchards where the egg-clusters were hidden in hollow limbs, difficult to find. The largest infestation (125 egg-clusters) was on land owned by Mr. Jenner on the road running north from East Putnam Four Corners near the Thompson line. As in Thompson and Woodstock single egg-clusters were not counted as separate infestations, and the trees were not banded. The horse-drawn sprayer was used in Putnam and 44 of the largest infestations were sprayed. After the spraying season was over, the men hunted for larvae around the infestations and destroyed 313 in the town. In one section of the town *Calosoma* beetles were observed feeding upon gipsy moth larvae.

Pomfret—41 infestations—1,042 egg-clusters.

During the war, much timber has been cut in Pomfret, and occasionally the inspectors reported that egg-clusters had been found on wood coming from some "set-up" back in the hills. The town was scouted in mid-winter and although scattered infestations occurred in all portions of its area, no very large colonies were found, the largest being a woodland infestation of 144 egg-clusters, on the west side of the road known as Wolf Den Drive. If any portion of the town is more thickly infested than another it is the northeastern part near the Putnam and Woodstock boundaries. As in Thompson, Woodstock and Putnam the trees were not banded and single egg-clusters were not counted as separate infestations. Of the 41 infestations, 33 were sprayed, and later 411 larvae were found and destroyed. The new automobile truck power sprayer was used here, and proved efficient and satisfactory. Recent scouting shows fewer infestations than last year, which indicates that the work was effective.

Union—2 infestations—5 egg-clusters.

This town has a large area, sparsely settled, and is difficult to cover in the scouting operations. The work was done by the Federal men, and two small infestations, of two and three egg-clusters respectively were discovered in the southeastern portion of the town. Here the trees were banded around each infestation. No spraying was done. It is believed that the gipsy moth has been eradicated from these infestations.

Ashford—5 infestations—44 egg-clusters.

Ashford was also scouted by Federal scouts and five infestations found, all in the eastern and southeastern part of the town. The largest colony contained 16 egg-clusters and was on land owned by Mr. Joseph McQuad near the Chaplin line. Four of the five colonies were banded, but on account of shortage of men, these infestations were not patrolled afterwards. No spraying was done in Ashford.

Eastford—33 infestations—548 egg-clusters.

Eastford was scouted by Federal men and 33 infestations were found, most of which are in the northeastern corner near Woodstock and Pomfret. Of the 548 egg-clusters, 369 were in three colonies, the largest containing 225 egg-clusters being in woodland owned by Mr. Andrew Chilkoth about a mile northeast of Eastford Post Office. In early spring State men banded the trees with "Raupenleim" around 17 of the largest infestations. One infestation was sprayed by the Federal auto-truck sprayer, and in the late winter three colonies of the egg-parasite, *Anastatus bifasciatus* Fonsc., were liberated in different sections of the town.

Chaplin—9 infestations—45 egg-clusters.

The results of scouting in Chaplin by the Federal men was the discovery of nine infestations divided into three groups—one in the northeastern, one in the southeastern, and one in the middle western portion of the town. The largest colony contained 14 egg-clusters, and was located on apple trees owned by Mrs. Anna Kinsell about one mile southwest of Chaplin Post Office. Of the nine infestations, six were banded with "Raupenleim" and none were sprayed.

Hampton—33 infestations—336 egg-clusters.

The infestations are scattered over all parts of the town, though most of them were grouped along an east and west line running

across the center of the town. The scouting was done by Federal men, and one infestation was sprayed by them. The largest colony contained 52 egg-clusters, and was on land owned by Mr. Martin Navin, Jr., near the Chaplin line. Two other colonies of 45 egg-clusters each were found, one on land owned by Mr. J. L. Goodwin, about one and one-half miles due east from the colony mentioned above, and the other on land owned by Mr. J. M. Woodward in the northeastern part of the town.

Brooklyn—60 infestations—876 egg-clusters.

Brooklyn was scouted by the State men and 60 infestations found, about half occurring in the northeastern portion of the town. A large woodland colony of 86 egg-clusters was found on the summit of Tatnic Hill, and this was cleaned of brush, etc. (3½ acres) by men working stormy days. This colony was sprayed in summer with our new auto-truck sprayer and 1,800 feet of hose had to be laid to reach all parts of it. Recent scouting shows only nine new egg-clusters where 86 were found last year. In all 43 infestations were sprayed in Brooklyn, and the men found and destroyed 511 larvae. Here as in Thompson, Woodstock, Putnam and Pomfret, single egg-clusters were not counted as separate infestations, though included in the total number of egg-clusters.

Killingly—62 infestations—1,411 egg-clusters.

Killingly was scouted by the state men and 62 infestations and 1,411 egg-clusters were found, the largest colony containing 107 egg-clusters occurring on apple and oak trees on land owned by Mr. J. T. French in East Killingly. Though the infestations are distributed over the town, the only portions thickly infested are the northern portion next to Putnam and the eastern portion next to Rhode Island. No banding was done in Killingly, but 40 of the largest infestations were sprayed with lead arsenate, both the horse-drawn sprayer and the new auto truck sprayer being used. While patrolling the infestations, the men destroyed 236 larvae. A few of the woodland colonies have been examined this fall and few egg-clusters were found.

Mansfield—2 infestations—86 egg-clusters.

Two infestations were found in Mansfield, both in the northern part of the town. One of 84 egg-clusters was on land owned by Mr. Adam Ciba, and the other of 2 egg-clusters was on land of Mr. B. E.

Taintor. The larger of these infestations was banded by the State men and sprayed by the Federal men. The latter did the scouting in the town.

Windham—2 infestations—34 egg-clusters.

Both of the two infestations in Windham were in the northeastern part of the town. One, of 14 egg-clusters was on large white oaks along the railroad near the Chaplin line on land of Mr. Edward Hall; the other contained 20 egg-clusters, and was located about one and one-half miles south of this point on land owned by Mr. W. A. Standish. Thirty-two and forty, respectively, bands of "Raupenleim" were applied by the State men. Both colonies were sprayed and the entire town scouted by the Federal employees.

Scotland—7 infestations—136 egg-clusters.

The infestations in Scotland are extended along the line of the State road running east and west across the center of the town. Five of these colonies are on the State road, the largest of 80 egg-clusters being on land owned by Mr. Byron E. Wilson. Four colonies were banded by State men and sprayed by Federal men.

Canterbury—37 infestations—508 egg-clusters.

This town was scouted by State men who were under the direct supervision of Federal foremen. Canterbury covers about 36 square miles and is one of the towns which have been found infested for several years, but the finding of 37 colonies was a heavier infestation than had been anticipated.

These colonies were scattered throughout the town, the northwestern corner being the most thickly infested. Six colonies were found which contained 40 or more egg-clusters, the largest of 99 egg-clusters being in an orchard of Mr. Charles Moffit about two miles southwest of Canterbury post office. Several colonies were cleaned of brush, etc., on stormy days but none of the infestations were banded or sprayed.

Plainfield—68 infestations—954 egg-clusters.

Previous to 1917 only one locality had been found infested in this town and that in the western portion near the Quinebaug River. In fact so few evidences of the gipsy moth had been observed in this town that during 1916 only a small portion was scouted. This past winter therefore it was deemed necessary to scout the entire town, with the result that 68 infestations scattered throughout the entire area, were located.

Many of these contained only a single egg-cluster each but there were several large colonies the largest containing 80 egg-clusters; this was on land owned by Mr. James Dawning.

During the summer three of the largest infestations were sprayed by the Federal men and the patrolling which was done resulted in the finding of 182 larvae.

Sterling—35 infestations—112 egg-clusters.

This town has been lightly infested for the past four years, but this past winter there was a large increase in both the colonies and in the number of egg-clusters found. About three-fourths of the infestations were in the northern half of the town, and 31 of them were in apple-orchards. The largest colony contained 47 egg-clusters and was located on apple trees owned by Mr. Carl Waas near the Rhode Island line about two miles north of the railroad. None of the infestations were sprayed or banded by State or Federal employees, but owners were advised to spray their trees in order to aid in controlling the pest.

Franklin—2 infestations—6 egg-clusters.

Franklin was scouted for the first time in the winter of 1917-18, and the result was the finding of two colonies of the gipsy moth, one containing two and the other four egg-clusters. These were both in the southern part of the town and both were located in orchards which made them easy to control. These were banded with "Raupenleim" but it was not thought necessary to spray either infestation.

Sprague—1 infestation—1 egg-cluster.

Only a single egg-cluster could be found in the scouting operations conducted by the Federal men in the town of Sprague. As this town has been considered infested for two or three years, it is remarkable that the pest was not more in evidence.

Lisbon—2 infestations—18 egg-clusters.

Lisbon was again found infested in 1918, nothing having been found since 1914. One colony containing 16 egg-clusters, was on land owned by Mr. Wade in the northwest corner of the town near the Canterbury line. The other was on land owned by Mrs. A. F. Strong on a dead end road in center of town about one and one-fourth miles south of railroad. The former was sprayed by the Federal men. No banding was done.

Griswold—13 infestations—234 egg-clusters.

The result of the winter's scouting in Griswold was the finding of 13 gipsy moth colonies. A majority of these were found in the northeastern section of the town near the Plainfield and Voluntown lines. This group of infestations were all small and the two large colonies found were in other parts of the town. One of these contained 34 and the other 77 egg-clusters, but both were favorable for control work as one was in a roadside oak and the other in an old apple-tree. All infestations were banded and during June, four of the most serious were sprayed.

Voluntown—9 infestations—54 egg-clusters.

Voluntown was only partially covered the preceding year and four single egg-clusters found. In fact only slight infestations were ever found there. It was thought best to go over the entire area in 1917-18 and this was done by the Federal men, with the result that nine infestations were discovered. These were all in the northern portion of the town and with one exception were all small colonies. This particular colony contained 30 egg-clusters and was found in an old apple-tree near the Rhode Island line. This infestation was banded as were others in this town, but no spraying was thought necessary.

Bozrah—2 infestations—19 egg-clusters.

The Federal men scouted Bozrah and for the first time found it infested. Two colonies were discovered, both near the Norwich line, the larger, containing 17 egg-clusters being in a group of roadside maples. Both infestations were banded but neither one was sprayed.

Norwich—6 infestations—128 egg-clusters.

This town was scouted some four years ago but as no traces of the gipsy moth were found it was not examined again until last year. The result was the finding of six colonies placing Norwich in the list of infested towns. These were well separated and extended in a line from north to south through the town.

The largest colony which contained 96 egg-clusters was located in the center of the town on land owned by Mr. Thomas Beetham. This colony was sprayed early in the season as was also one other in Norwich. All colonies were banded but it was impossible to do any patrol work.

Preston—5 infestations—128 egg-clusters.

Preston had not been scouted for two years, and when the Federal men finished the scouting this year five infestations had been

discovered. These were widely separated and contained two rather large colonies, one of 72 and the other of 39 egg-clusters. The former was in an old orchard about half-way between Preston City and Norwich while the latter was located in a pasture near the North Stonington town line. All of the infestations were banded but there was no spraying done in this town.

Montville—0 infestations—0 egg-clusters.

The roads in the eastern part of the town were scouted but no infestations were found.

Ledyard—4 infestations—102 egg-clusters.

In 1917-18, this town was found infested for the first time. Though the four colonies were well scattered, the most important one containing 90 egg-clusters was found in an old apple-orchard on the old Stoddard farm near Stoddard's wharf in the western portion of the town. This orchard though sprayed by the Federal men had considerable undergrowth on one margin and the condition of the nearby roads made spraying difficult.

Both "Raupenleim" and tanglefoot were used in the banding of the colonies in this town but labor conditions made proper patrolling impossible.

North Stonington—6 infestations—55 egg-clusters.

The six colonies found in North Stonington were widely separated, the most serious being a little south of Pendleton Hill, on high elevation scattered through a section of woodland. Several broken stone walls and much undergrowth made this colony a difficult one to treat. All infestations were banded but no spraying was done in North Stonington.

Groton—1 infestation—2 egg-clusters.

During the winter of 1916-17 several spruce trees were shipped to the Plant Estate, from the heavily infested district in Massachusetts. At the time they were sent they were covered with ice and snow and it was impossible for the inspection to be really thorough and accordingly these trees were given special attention this year. The result was the finding of two egg-clusters, both small and both found on the same tree, a spruce. These were treated in the usual manner and as the nearby growth is well cared for and is not favorable for food plants it is doubtful if there will be a recurrence of this pest in this vicinity. No spraying or banding was done. The

entire town was subsequently scouted by the Federal men but no other infestations were found.

Stonington—4 infestations—120 egg-clusters.

As a result of the winter's scouting by Federal men, four gipsy moth colonies were found, all being located in the eastern portion of the town near the Rhode Island boundary. The largest colony was found in the Pawcatuck section of Westerly and this together with the other Stonington infestations was banded early in the season.

There was no spraying done in this town.

STATISTICS OF INFESTATIONS.

The following table summarizes the work by towns:

Towns	No. of Infestations	No. of Egg-clusters Destroyed	No. of Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
Thompson	275	7,255	0	149	1,190
Woodstock	46	1,057	0	30	9
Putnam	98	2,787	0	44	313
Pomfret	41	1,042	0	66	411
Eastford	33	548	490	1	0
Ashford	5	44	147	0	0
Killingly	62	1,411	0	40	236
Brooklyn	60	876	0	43	511
Hampton	33	336	0	1	0
Chaplin	9	45	183	0	0
Mansfield	2	86	7	1	0
Sterling	35	412	496	0	0
Plainfield	68	954	346	3	182
Canterbury	37	508	0	0	0
Scotland	7	136	80	4	0
Voluntown	9	54	327	0	0
Griswold	13	234	460	4	0
Lisbon	2	18	0	1	0
Sprague	1	1	22	0	0
North Stonington	6	55	68	0	0
Stonington	4	120	96	0	0
Groton	1	2	0	0	0
Union	2	4	0	0	0
Windham	2	34	72	2	0
Preston	5	128	105	0	0
Norwich	6	128	206	2	0
Ledyard	4	102	48	1	0
Bozrah	2	10	23	0	0
Franklin	2	6	122	0	0
Totals	870	18,393	3,298	392	2,852

Some of the bands were of tree tanglefoot, and some of "Raupenleim." The "Raupenleim" was applied with a hand apparatus holding about three pints of material, and called a gun. At first an attempt was made to record the number of guns instead of the number of bands but this was discontinued. Thus in Eastford 23 guns supplied material for 490 bands. In Union four guns were applied, approximately 100 bands.

In Thompson, Putnam, Woodstock, Pomfret, Brooklyn and Killingly, the single egg-cluster infestations were not recorded as separate infestations but were included among the egg-clusters destroyed.

Brown-Tail Moth Work.

The brown-tail moth has been conspicuous by its absence during the past year, and control measures were unnecessary. In 1915, the area quarantined by the Federal Horticultural Board included Granby, Simsbury, Bloomfield, West Hartford, Old Saybrook and all towns east of the Connecticut River, a total of 71 towns. In 1917 the boundary of the quarantine was changed, thus releasing eight towns, namely: Granby, West Hartford, Hartford, East Hartford, Manchester, Glastonbury, Portland and East Haddam. Further changes were made in 1918, which released from quarantine the following: Suffield, Enfield, Somers, East Granby, Windsor Locks, East Windsor, Ellington, Simsbury, Bloomfield, South Windsor, Vernon, Tolland, Bolton, Coventry, Andover, Columbia, Chatham, Marlboro, Hebron, Lebanon, Colchester, Salem, Montville, Old Saybrook, Lyme, Old Lyme, East Lyme, Waterford, and New London, 29 towns. This change was based upon an examination of the territory from Long Island Sound northward to the Massachusetts line, by the Federal scouts. The entire infested area was covered somewhat hastily by the combined efforts of State and Federal men and only one winter nest was discovered—and that in Woodstock. A nest was reported from Stonington but this report was not verified.

Appropriation and Expenditures.

The General Assembly of 1917 appropriated $40,000.00 for the biennial period ending September 30, 1918, for suppressing the gipsy moth and the brown-tail moth and for inspecting imported nursery stock. As the brown-tail moth has largely disappeared, it has not seemed necessary to expend much money in combating it. The shipping and other conditions brought about by the war have

reduced the quantity of imported nursery stock entering Connecticut, so the cost of inspecting it has been considerably less than the average for the past few years, or about $363.66 altogether for the year. Consequently nearly all of the appropriation thus far expended has been for gipsy moth work. On account of the need for more spraying apparatus and equipment a new auto-truck power sprayer was purchased and somewhat more than half of the appropriation was expended during the year just ended. Nevertheless this outfit will last for several years, so its cost will not need to be duplicated in 1919.

FINANCIAL STATEMENT.

Appropriation for biennial period ending Sept. 30, 1917	$21,000.00	
Amount expended, year ending Sept. 30, 1916	13,027.67	
Balance		$7,972.33
Additional appropriations (Deficiency)		3,000.00
		$10,972.33
Amount expended, year ending Sept. 30, 1917		10,573.38
Balance		$ 398.95
Appropriation for biennial period ending Sept. 30, 1919	$40,000.00	
Amount expended, year ending Sept. 30, 1918	22,644.18	
Balance	$17,355.82	

CLASSIFIED EXPENDITURES, YEAR ENDING SEPT. 30, 1918.

Salaries and wages:		
I. W. Davis	$1,125.00	
J. T. Ashworth	1,170.00	
J. A. McEvoy	1,010.58	
F. C. Rich	739.84	
K. Buffington	761.02	
R. E. Smith	611.68	
R. V. Harris	651.92	
W. P. Colvin	619.20	
D. LaBelle	487.44	
E. A. Smith	419.52	
P. H. Shea	405.20	
H. Bodo	428.48	
T. R. Ward	375.54	
W. G. Greene	320.10	
Other labor	2,565.64	
		$11,691.16

Printing and Illustration	$ 4.98
Postage	.23.43
Telegraph and Telephone	59.86
Office Supplies	12.40
Express, freight and cartage	187.97
Machinery, tools, and supplies, including gasoline	8,357.74
Insurance	323.04
Rental and storage	233.50
Travelling expenses	260.77
Automobile tires and repairs	644.51
Rebate to towns	66.50
Inspection of imported nursery stock	363.66
Miscellaneous	414.66
Total	$22,644.18

State Finance Board Visits Stripped Woodland in Massachusetts.

Early in the season Mr. Davis arranged with members of the State Finance Board to make a trip into Massachusetts to see some of the damage done to vegetation by the caterpillars of the gipsy moth. Inasmuch as no stripping has as yet been noticeable in Connecticut: appropriations are asked for at each session of the General Assembly, and as the Finance Board goes over such matters prior to the sitting of the General Assembly, and acts conjointly with the Committee on Appropriations, such a trip seemed advisable. Consequently the trip was arranged for July 12th, 1918, but as Mr. Davis enlisted in military service prior to that date he was not present to conduct the others to the defoliated woodland.

The members gathered at Putnam Thursday evening July 11, and started early the following morning in the automobiles used in the gipsy moth work. One car was driven by Mr. Ashworth and the other by Mr. Rich. The following made up the party: Robert V. Magee, John Wadhams, State Board of Finance; Senator E. S. Boyd, Edward F. Hall, Frank E. Morgan, and John G. Wightman, Committee on Appropriations; Walter O. Filley, State Forester; W. E. Britton, State Entomologist; and Messrs. Ashworth and Rich of the gipsy moth force—ten in all.

The route led through Chepachet and Providence, R. I., Fall River, New Bedford, Fair Haven to Marion, Mass., where a luncheon had been arranged, the occasion being the meeting of the Massachusetts Tree Wardens' Association. After luncheon the

Connecticut party was escorted by Mr. A. F. Burgess of the Federal Bureau of Entomology to a piece of woodland northeast of Marion and probably in the town of Wareham where several acres of native tree growth had been stripped of leaves as shown in the accompanying photographs on plates XXII, b, and XXIII.

The entire trip of 182 miles was made without any unfavorable incident, not even a tire puncture, and the party reached Putnam at seven o'clock in the evening. The members expressed themselves as being well repaid in terms of information gained, for making the trip.

Future Needs.

The Connecticut area now infested by the gipsy moth is not an isolated colony but is on the southwestern edge of the large infestation covering the whole of Rhode Island, the eastern two-thirds of Massachusetts, the southern two-thirds of New Hampshire and the southwestern portion of Maine. Extermination, though perhaps not impossible, is extremely improbable with the appropriations that are apt to be made for such work.

The increase in the cost of all materials, and especially of labor, has rendered any given appropriation arranged on a pre-war basis, inadequate. It is necessary to increase the wages of the men from time to time as they gain in efficiency and experience. Most of them could now earn far more in other lines of work. Certain qualifications and training are essential in good scouts, and at present there is little competition. Moreover, all materials and supplies have gone up in price and, in order to do the essential work, it takes considerably more money than a few years ago.

There has not been an appropriation large enough, since the summer wind spread of 1913, to adequately scout all the territory. Hundreds of acres of woodland have never been thoroughly examined either by the State or Federal Scouts. It is possible, therefore, that additional and undiscovered infestations now exist in some of the unexamined woodland areas, and that the pest is increasing there soon to break forth and spread to adjacent territory. Connecticut has been extremely fortunate in discovering and checking the pest so soon after it gained a foothold in the State, but the successful work already accomplished would not have been possible except through the hearty co-operation of the Federal Bureau of Entomology, which has expended in Connecticut each year an amount approximating that expended by the State and during the

past year has expended about $15,000. The policy of the Federal Bureau is to help those states which try to help themselves.

To give the gipsy moth suppression work its greatest possible measure of effectiveness, larger appropriations must be provided for it, and for the coming biennial period an appropriation of $80,000 has been requested. In 1917, $60,000 was requested and $40,000 granted. The increase in the number of towns infested, means that more men will have to be employed to scout these towns, and more men and more spraying apparatus will be required to spray the infestations. Even if no more towns become infested and $80,000 is appropriated $40,000 per year will not be enough to do the work. There are 617,124 acres or 964.25 square miles in the infested towns. Thus we have nearly 1,000 square miles of territory to cover each year with $40,000 which means only a little over $40.00 per square mile. Even if the Federal Bureau assists by expending a like sum $80.00 per square mile will not begin to adequately suppress this pest in a thickly infested region. It goes without saying that all of this territory will soon become thickly infested if adequate provision is not made for holding the pest in check.

RECORD OF TREATMENTS IN AN ATTEMPT TO CONTROL THE STRIPED CUCUMBER BEETLE.

Diabrotica vittata Fabr.

By W. E. Britton and M. P. Zappe.

This work is in continuation of experiments and observations begun several years ago to ascertain the principal insects attacking cucurbitaceous plants in Connecticut, and how to control them (See Reports of this Station, 1908, page 805; 1916, page 116; 1917, page 262).

A half acre of land at the Station farm at Mount Carmel, was devoted to this purpose and was planted to Hubbard squashes 18 rows, Winter Luxury pumpkins 9 rows, Davis' Perfect cucumber 3 rows, Osage muskmelon, 1 row, on May 23, 27, and 28. As soon as the plants appeared above ground the squashes, pumpkins and cucumbers were attacked by the beetles. The melons were almost free from them. The treatments were applied on June 6, 7, and 8. There were many beetles present especially on the squashes and pumpkins. The materials used, how applied, kind of plants, effectiveness and injury to plants are all given in the following table:

Treatment.	How applied.	Date.	Kind of Plants.	Effectiveness.	Injury to Plants.
Lead Arsenate	Covered leaves with dry powder	June 6, 1918	Squash, 3 rows	Few beetles	None
Land Plaster	Covered leaves with dry powder	June 6, 1918	Squash, 3 rows	Few beetles	None
Ground Limestone	Covered leaves with dry powder	June 6, 1918	Squash, 3 rows	Beetles present	None
Dry Bordeaux	Covered leaves with dry powder	June 7, 1918	Squash, 1½ rows	Treatment washed off that night. Many beetles	None
Dry Bordeaux	Covered leaves with dry powder, 2 applications	June 7 & 8, 1918	Squash, 1½ rows	No beetles	None
Commercial lime-sulphur	Sprayed	June 8, 1918	Squash, 3 rows	Many beetles	None
Laurel green and air slaked lime } equal parts	Dry powder on leaves	June 8, 1918	Squash, 3 rows	Very few beetles	Leaves burned slightly
Fish oil and sawdust	Sprinkled around plants	June 8, 1918	Pumpkins, 1 row	Only 8 beetles on row	None
Sulphur and lead arsenate equal parts	Dry on leaves	June 8, 1918	Pumpkins, 2 rows	Only 2 beetles on 2 rows	None
Laurel green 1 oz., air slaked lime 1 oz., molasses ¼ pt., water 1 gallon	Sprayed	June 8, 1918	Pumpkins, 3 rows	Quite a few beetles	None
Kerosene emulsion 1-10	Sprayed	June 8, 1918	Pumpkins, 3 rows	Not many beetles	None
Air slaked lime	Dry on leaves	June 8, 1918	Melons, 1 row Cucumbers, 1 row	Thysanurids Only a few beetles	Burned slightly
Lead Arsenate	Dry on leaves	June 8, 1918	Cucumbers, 2 rows	Thysanurids Only a few beetles	None

The treatments giving favorable results, in the order of their effectiveness, are as follows:

Lead Arsenate and Powdered Sulphur equal parts, dusted on both sides of the leaves caused no injury and very few beetles were found feeding on the plants in the two rows treated.

Lead Arsenate was fairly effective.

Dry Bordeaux, where it did not wash off, seemed to prevent injury by the beetles. Doubtless acted as a repellent.

Land Plaster and Ground Limestone did not adhere to the leaves in a satisfactory manner, and for that reason was less effective than some of the finer and lighter powders.

Air-slaked Lime, though fairly effective in keeping off the beetles, caused some burning of the leaves.

Fish Oil and Sawdust mixed together and sprinkled on the ground around the plants seemed to repel the beetles until the plants were out of danger.

Any of the dry powders will adhere better and prove more effective, if applied to moistened foliage, in early morning when still wet with dew, just after a shower, or after first wetting the plants by spraying them with water.

SPRAYING EXPERIMENTS AT CLINTONVILLE.

By M. P. Zappe.

These experiments were conducted in the orchard of S. A. Smith & Son, near the Clintonville railroad station in the town of North Haven. It is the same orchard where work was done last year an account of which was published in the report of this station for 1917, page 259.

The first application was made May 6th and 7th, just before the blossoms opened. A hard southwest wind in the morning of May 6th, prevented us finishing the spraying of the trees, and about two-thirds of each tree was covered with the spray. In the afternoon the wind subsided and these trees were finished. The remaining trees were sprayed the following day. Spray materials were applied as follows:

Rows 1, 3 and 4.

Lead arsenate (powdered)	3 lbs.
Nicotine solution	1 pint
Commercial lime-sulphur	2 gal.
Water	100 gal.

Rows 5 and 6.

Lead arsenate (powdered)	3 lbs.
Nicotine solution	1 pint
Copper sulphate	8 lbs.
Lime	8 lbs.
Water	100 gal.

Row 2 was left untreated as a check.

The orchard was sprayed again on May 17 and 18, just after the petals had fallen. The bloom was very light, especially on the Baldwins. At this time insects were scarce in the orchard; few aphids could be seen and a few canker worms were feeding upon the leaves.

Spray materials were applied as follows:

Rows 1, 3, 4, 5, and 6.

Lead arsenate (powdered)	3 lbs.
Nicotine solution	1 pint
Commercial lime-sulphur	1½ gal.
Water	100 gal.

The fruit was harvested and scored on September 20, 21, 23 and on October 15. Though the bloom was light the yield of first class fruit from the orchard was larger than last year, due no doubt to the absence of aphids which were present last year and stunted some of the fruit rendering it worthless except for cider.

Altogether 14,961 apples were examined. The results are not striking and apparently red bugs were not abundant. The figures are given below:

ROW	I Per cent.	*II Per cent.	III Per cent.	IV Per cent.	V Per cent.	VI Per cent.
Good	83.1	75.1	90.1	83.3	76.6	83.7
Codling Moth	6.1	5.	7.9	7.2	6.5	9.9
Curculio	4.5	7.8	.6	6.5	14.4	4.1
Maggot	.3	.1	.0	.3	.01	.3
Other chewing insects	3.9	6.7	.5	1.7	1.2	.9
Red Bug	1.1	4.8	.3	.7	.9	.9
Aphid	.7	.1	.1	.3	.01	.0

* Check. No treatment.

TESTS OF SPRAYS TO CONTROL THE POTATO APHID.

By W. E. Britton and M. P. Zappe.

The usual methods of spraying to kill aphids on potatoes have been more or less unsatisfactory because nicotine solution in combination with lead arsenate, or Bordeaux mixture, or both, does not spread as freely and is not as effective as when used with soap in spite of the fact that statements are often made that these materials will take the place of soap. There is some danger in combining the soap-nicotine mixture with lead arsenate because many of the soaps contain a free alkali, usually sodium, in the form of hydroxide or caustic, and this unites with the arsenic in the poison forming sodium arsenate, a substance which is soluble and destructive to plant tissues. If used in Bordeaux mixture, the soap tends to form a sticky substance which clogs pump and nozzles.

The nicotine-soap spray may be applied separately and this is often recommended and practiced. But this means an additional operation at a time when each day counts and each man's services are valuable, if indeed, help of any kind be procured, which was difficult in 1918. Hence, to save labor it is desirable and important to reduce the number of spraying operations to the minimum, but this must not be done at the expense of effectiveness, and the risk of injury must not be too great.

In order to devise a rational treatment whereby some of these insecticides may be combined, a number of tests were made of promising materials during 1918. The different materials were prepared with the co-operation of Dr. E. M. Bailey of the chemical department of the Station and the field tests were made by Mr. Zappe on potatoes growing at the Station farm at Mount Carmel. These potatoes were infested with aphids which were increasing in abundance and it was evident that the pest must be checked soon or the crop would be greatly lessened. The tests were made from June 29 to July 26. The materials tested were as follows:

Nicotine Solution.

"Black Leaf 40," one teaspoonful in one gallon of water killed only a few aphids, apparently because the aphids are not wetted by the spray. The waxy or oily excretions, cause the spray to roll off in drops without really coming in contact with their bodies. When

the same proportion of nicotine was used and enough soap added to made the mixture feel soapy, and suds appear readily when shaken, it will kill a large percentage when sprayed upon them.

Salt Solution.

Common salt, one ounce in one gallon of water, neither killed any aphids, nor caused injury to the foliage.

Commercial Lime-Sulphur.

This liquid one part in 50 parts of water, killed only a few aphids and caused no injury to the plants.

Commercial Lime-Sulphur and Nicotine Solution.

Commercial lime-sulphur and nicotine solution ("Black Leaf 40") one tablespoonful in one gallon of water, killed a few aphids and caused no injury to the foliage.

Nicotine Solution and Molasses.

Nicotine Solution ("Black Leaf 40") one teaspoonful, molasses, one tablespoonful, in one gallon of water killed a few aphids and caused no foliage injury.

Casein, Arsenate of Lime and Nicotine Solution.

The use of casein as a spreader has been recommended by several workers, especially when used in connection with lime. Consequently this was thought worthy of trial and was employed in our tests. Professor Lovett* regards it as being worthy of much additional study. The material was prepared as follows:

Quick Lime .....3.5 grams
Powdered Casein .....1.5 grams

This was made into a thin paste by the addition of water, and continual stirring, and used at the rate of 4 ounces of this paste in a barrel of 50 gallons of spray mixture. "Black Leaf 40" was used at the rate of one teaspoonful in a gallon of water, and poison was added in the form of lead arsenate (powdered) one ounce. In another lot the same weight of calcium arsenate was used. The latter caused some injury to foliage, but no injury followed the use of lead arsenate. The casein in the amount used was of questionable value as a spreader and did not seem to render the nicotine solution any more effective in killing aphids.

* Journal of Economic Entomology, Vol. II, p. 66, 1918.

By this time the aphids were increasing rapidly and must be checked to save the crop. Many of the dealers had sold out on nicotine solution and others had raised the price. The following materials were used independently of arsenical poisons, in an attempt to control only the aphids.

Nicotine Oleate.

The possibility of this material was first brought to our attention by a note published by William Moore* and it was prepared as follows:

"Nicofume"	3.25 grams
Oleic Acid or Red Oil	2.28 grams
Water	1 gal.

This material did not spread as satisfactorily as "Black Leaf 40" and soap, and was not any more effective in killing aphids. It was easy to make and apply and caused no injury to the plants.

Nicotine Oleate and Soap Bark.

This was prepared after the following formula:

"Nicofume"	5 grams
Oleic Acid or Red Oil	3.5 "
Soap Bark	5 "
Water	1 gal.

The soap bark was made into an infusion and added to the combination. As an aphid-killing spray this was slightly more effective than the preceding.

Glycerine (40 cc.) was substituted for the soap bark, and when sprayed upon the plants killed many aphids but neither preparation seemed to be any more effective than "Black Leaf 40" and soap.

Kerosene Emulsion.

The directions for making kerosene emulsion usually call for one-half pound of soap, 2 gallons of kerosene, with a dilution sufficient to make about 30 gallons. These are the amounts named in the Station Spray Calendar (Bulletin 199) published a year ago. When tried against the potato aphid, there seemed to be too much kerosene for the soap and some "burn" or injury resulted. Consequently the proportion of soap was increased and a lesser dilution used. Soap was purchased by the box at wholesale price, and the cakes averaged about 10 ounces in weight.

* Ibid, page 341.

As it seemed desirable to make just enough each time for a barrel of mixture, the quantities may be stated as follows:

Kerosene	4 gal.
Soap (about 30 ounces)	3 cakes
Water to make	50 gal.

The soap was shaved into thin slices with a tool for shredding cabbages, and dissolved in hot water on a stove which had been taken into the field for the purpose as is shown on plate XXVIII, a. The hot soap suds and kerosene were churned by means of a bucket pump, until a creamy mass was formed in which the oil did not separate on standing. The operation is shown on plate XXVIII, b.

This emulsion was used independently of arsenical poisons and was very effective in killing aphids. All that were hit by it died at once. A slight injury to foliage was noticed, and the formula changed by increasing the soap and diminishing the kerosene as follows:

Kerosene	3 gal.
Soap (about 40 ounces)	4 cakes
Water to make	50 gal.

This formula seemd to be as effective in killing aphids as the preceding and there was no injury to foliage. A greater portion of the field was sprayed with kerosene emulsion a hand barrel pump being used as is shown on plate XIII, b, of Bulletin 208, which is a part of the Station Report for 1918.

The price of materials to make a barrel of spray liquid at this time were about as follows:

3 gallons kerosene @ .14 (retail)	$ .42
4 cakes soap @ .06 (wholesale)	.24
Total	$ .66

Nicotine solution and soap at current prices was more than twice as expensive, but required less work in preparation. The cost of nicotine and soap is given below:

Nicotine sulphate ("Black Leaf 40") 1 pint	$1.31*
Soap, three cakes, @ .06 (wholesale)	.18
Total	$1.49

Materials for the kerosene emulsion could be obtained of any grocer in city or country, and nicotine solution was hard to get on account of the unusual demand for it.

* In gallon lots.

THE ORIENTAL PEACH MOTH.

Laspeyresia molesta Busck.

Introduction.

In the report of this Station for 1917, page 315, an announcement was made of the occurrence of the Oriental peach moth in Connecticut, and such facts as were then known about this insect were included. Since the publication of last year's report additional information has been obtained, and it is deemed advisable to give here a summary of the status of this new and threatening pest of fruits.

Careful studies of the Oriental peach moth have been made by Dr. A. L. Quaintance and his associates, Division of Deciduous Fruit Insect Investigations, Bureau of Entomology, Washington, D. C., and by Dr. Philip Garman of the Department of Entomology, of the Maryland Agricultural Experiment Station, College Park, Md. The trial grounds of the U. S. Department of Agriculture, at Arlington, Va., where nearly all deciduous orchard fruits are injured have furnished a good opportunity for the work of Dr. Quaintance and his associates. College Park, Md., is not far away, so the results of the two separate investigations should correspond very closely. The Bureau of Entomology has published an illustrated poster showing the injury caused to the twigs and fruit and giving considerable information. A paper entitled "Further Notes on *Laspeyresia molesta*" by W. B. Wood and E. R. Selkregg of the Bureau of Entomology appeared in the Journal of Agricultural Research in April, 1918, Vol. XIII, page 59. Dr. Garman's preliminary studies were embodied in Bulletin 209 of the Maryland Agricultural Experiment Station, entitled, "The Oriental Peach Pest." From these publications most of the facts set forth in this paper, were gleaned.

A conference of entomologists, which the writer attended, was held at Washington, March 18, to consider this insect and control measures were discussed. It was agreed that the first essential was to scout around the infested points and in other places in each state to determine the present distribution of the pest. Consequently the Bureau of Entomology employed men to scout in the infested and other states; men for this work to be nominated by, and to be partly under the direction of, the entomologists in the states where they are at work. Mr. Ernest D. Brown of Clinton, Conn. was appointed to scout Connecticut and began April 1. Mr.

Zappe worked with him in Stamford and Greenwich for the first ten days to get the work properly started. Mr. Brown worked in the State until about October 1st, when he examined portions of Rhode Island, Massachusetts and New Hampshire. He covered the shore region in Connecticut and made many trips inland, especially to visit large orchard areas. He also accompanied the men while inspecting nurseries, and in this way examined many nearby fruit trees as well as trees in the nurseries.

Original Home.

It is believed that this insect was introduced into the United States a few years ago on flowering cherry trees from Japan. On rearing the adult from the larva, it proved to be new to science. Since then, the same species has been reared from nursery stock coming from Japan.

Distribution in Connecticut.

Our knowledge of the distribution of this insect in Connecticut is based upon the inspections of Mr. Brown in 1918. Strange to say the only specimens of this insect found were larvae in Stamford, near where it was first discovered in 1917. Here the larvae were found boring in the twigs and later tunnelling in the fruit.

Twig injury was found in each of the four Southern or shore counties but was not discovered in the orchards far inland, or in the northern counties. This twig injury may have been caused by the Oriental peach moth, or by the peach twig borer *Anarsia lineatella* Zell. which does similar injury. The former has a pinkish white larva and the latter a brown larva, so when the larva is found in the burrow, there is no uncertainty but when only empty burrows are found it is not possible in most cases to determine which insect excavated them.

Therefore the reported "typical injury" may not mean that the Oriental peach moth is present. Such injury was found by Mr. Brown in each of the following towns, arranged by Counties:

Fairfield County: Greenwich, Westport, Fairfield, Darien, Stratford, Norwalk, New Canaan.

New Haven County: Milford, Woodbridge, New Haven, North Haven, Branford, Cheshire, Guilford, Wallingford, Madison.

Middlesex County: Clinton, Old Saybrook.

New London County: Old Lyme, New London, Niantic.

The insect itself was found in the town of Stamford.

Distribution in the United States.

The Oriental peach moth is now known to occur in the District of Columbia, Northern Virginia, Maryland, Southeastern Pennsylvania, Northern New Jersey, Southeastern New York, Connecticut and probably Northern Delaware. So-called typical injury was found in Delaware, Mississippi, and West Virginia and doubtful injury in two or three other states but as has already been stated both the typical and doubtful injury may have been caused by *Anarsia*. Further searching may reveal the presence of *Laspeyresia* in other sections, but so far the evidence is negative as many other states have been scouted without finding any traces of the insect, or of any suspicious twig injury.

Status as a Pest.

It is yet too soon to determine whether or not this insect will become an important pest in the commercial orchards of the Eastern States. In the vicinity of Washington, D. C., it appears to be very destructive. In New Jersey thus far the injury to fruit has been negligible in commercial orchards and there are about three injured twigs per tree. In the orchard of the Maryland Agricultural College, according to Professor E. N. Cory the average injury is less than three per cent. and the maximum injury is about 12 per cent.

In Connecticut the twig injury has been scattered and not abundant in commercial orchards, and the only larvae found were in city back yards in the vicinity of Stamford.

It is never wise to make predictions. Entomologists who have observed the work of this insect near Washington, D. C., regard it as a serious and threatening pest. The observations made in New Jersey and Maryland lead us to hope that it may not prove so destructive as was feared.

Injury to Twigs.

The larvae of the Oriental peach moth seem to show a preference for peach and quince twigs, over the twigs of other kinds of fruit trees, and if the insect is present in a locality where peaches are grown, some injured twigs can usually be found. This injury is always to the newest growth and often causes the twigs to branch and thicken at their terminals. Such twigs are easily seen on the dormant trees in winter.

The larvae which live through the winter usually attack the new shoots in May, often causing the terminal leaves to turn brown and die. Such a condition may be found on peach, quince and on sweet cherry, but seldom occurs on other kinds of trees. The larvae may forsake their burrows and enter other twigs, thus injuring several twigs or perhaps trees. Injured twigs are shown on plate XXIX, b.

Injury to Fruit.

Though called the Oriental peach moth, it is by no means confined to the peach, and this is even more evident concerning fruit injury than twig injury. The first injury is noticed in peaches when the fruit is about the size of chestnuts. In other kinds of fruits the injury shows somewhate later. The first-brood larvae tunnel in the twigs early in the season.

The second-brood larvae also work in the twigs but when about half grown some of them attack the fruit, boring into the side of a green peach and living therein until mature. They sometimes emerge at the entrance hole but usually elsewhere. The green fruit usually exudes drops of gum, but does not fall from the tree or decay.

The third-brood larvae generally hatch when the early varieties are ripening. Some tunnel first in the twigs, and later in the fruit. Others go at once into the ripening fruit usually near the stem, and work beneath the skin of the softening fruit and inward to the seeds and along the grooves in the pit. Entrance to a fruit is also gained where covered by a leaf or where two fruits touch each other. When the Elberta and later varieties are ripening, the fourth-brood larvae hatch and go at once into the fruit. This is when the greatest damage is done, and the injury may continue until all peaches have been harvested. Garman* found that from 5 to 15 per cent. of the fruit was infested in Maryland. The latter part of the summer and especially in September the larvae attack apples and quinces often causing serious injury. Wood and Selkregg** record the rearing of 354 larvae from one and one-half bushels of Ben Davis Apples and more than half of the apples in the orchard were injured. In quince an average of nine larvae per fruit occurred, and in one quince 30 larvae matured.

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* Bulletin 209, Maryland Agricultural Experiment Station, 1917.

** Journal of Agricultural Research, vol. XIII, page 63, 1918.

Thus it will be seen that this insect threatens the fruit-growing industry wherever it occurs. An infested peach is shown on plate XXIX, a.

Number of Broods.

Garman* states that there are four generations each year, but Wood and Selkregg** mention the larvae of the fifth generation as hatching late in the season and attacking peach twigs.

Food Plants.

This pest has been reported as injuring the twigs of peach, plum, cherry, flowering cherry, quince, apricot, and apple very slightly. The larvae infest the fruit of peach, quince, pear, apple and flowering quince.

Life History and Habits.

The eggs are laid singly on the under side of the leaves on peach. Near Washington, D. C., the first eggs were deposited May 2, and the last ones October 8. The period of incubation varies from four days in midsummer to seven days in cooler weather. The larval period varies from 8 to 13 days with an average of about 11 days, during which time the larvae are feeding in twigs or fruit. Larvae often leave their feeding places and enter other twigs or fruit, and though there is usually only one larva in a twig, many may infest a peach or quince at the same time.

According to Dr. Garman* larvae obtained from eggs deposited after August 25, hibernated in cocoons after the first of September, but did not pupate. This is probably the usual method of hibernating. The pupa stage lasts from 9 to 13 days with an average of 10 days, during the growing season. When mature the larva eats out cavities in the sides of the twigs, or whatever surface is near at hand and suitable for the purpose, and there constructs a firm cocoon, those found late in the season usually being in crevices in the bark and very inconspicuous and difficult to detect.

The entire life cycle lasts about 26 days. The adults fly and lay their eggs during the night.

Means of Spread.

There is some danger that this insect may be disseminated by means of nursery stock as the winter cases or cocoons are sometimes

* Bulletin 209. Maryland Agricultural Experiment Station, 1817.

** Journal of Agricultural Research, Vol. XIII, page 63, 1918.

made on nursery trees. Probably the pest was brought into this country on nursery stock. So far, though much searching has been done, this insect has not been found in Connecticut nurseries. The principal means of spread, other than that of natural flight, seems to be by the way of fruit. The danger of dissemination in fruit as compared with nursery stock is in the ratio of about 95 to 5, in the opinion of those who have studied the pest. Any infested fruit taken into a new region, if not destroyed at once, may start a new colony. If the fruit is stored for a time or if discarded cores and parings are thrown out, the larvae will emerge and may attack nearby trees, or if mature, will transform. Females emerge from the cocoons and lay eggs. In this manner the pest may soon become widely distributed.

Natural Enemies.

In Maryland according to Dr. Garman,* two parasites have been reared, both belonging to the hymenoptera or four-winged flies. One, a chalcid, *Trichogramma minutum* Riley was reared from the eggs, 80 per cent. of which were parasitized. The other a braconid, *Macrocentrus* sp. was reared in small numbers from the larvae.

Wood and Selkregg** have reared six primary hymenopterous parasites, of which *Macrocentrus* sp. was the most abundant. This species is also a parasite of the codling moth *Phaeogenes* sp. was second in point of abundance, and several specimens of *Ascogaster carpocapsae* Viereck were obtained. There were also reared one specimen each of *Glypta vulgaris* Cress., *Spilocryptus* sp. and *Mesostenus* sp. Two secondary parasites were obtained, *Dibrachys boucheanus* Ratz., and *Cerambycobius* sp.

One dipterous parasite *Hypostena variabilis* Coq. belonging to the family Tachinidae was obtained from a cocoon.

It was reported by Professor E. N. Cory, State Entomologist of Maryland that about 60 per cent. of the larvae and 50 per cent. of the pupae were parasitized in Maryland.

There is evidence to show that the larvae are eaten by spiders and by lace-wing larvae, and that the cocoons in some instances are opened by woodpeckers, and the contents devoured.

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* Bulletin 209 Maryland Agricultural Experiment Station, 1917.

** Journal of Agricultural Research, Vol. XIII, page 70, 1918.

Description.

Egg. Diameter about .7 mm., white, circular, flat, with surface sculptured; the center granlulate with reticulate ridges extending a short way inward from the margins. Somewhat smaller and less reticulated than the egg of the codling moth.

Larva. Length about 12 mm., white varying to pink with head black and shining. Prothoracic and anal shields yellow to brown. Spiracles small, circular, dark brown or black. Brown lateral and dorsal setae are borne on each segment.

Pupa. Length 4.5 to 5.5 mm. uniform brown, smooth: abdomen composed of ten segments, the last three apparently grown together to form a truncated cone. The basal margins of segments 2 to 7 each bearing dorsally a transverse row of heavy setae or spines.

Adult. Wing expanse 10 to 15 mm. (about half an inch) fore-wings, predominant color dusky brown, rather indistinctly marked with a row of short diagonal double dashes on the costal margin, with intervening spaces blackish and produced into indistinct wavy lines extending partly across the wings. Towards the distal margin and parallel with it is a curved row of six small dark spots surrounded by whitish scales; often with a curved dark band inside this row of spots. Rear wings dark brown with the front margins white, and the female with a yellowish area along the rear angles.



Figure 8. Larva of Oriental peach moth, about four times enlarged. (After Wood and Selkregg, Bureau of Entomology, U. S. Dept. of Agriculture.)

The larva is shown in figure 8, and the adult in figure 9.

For a more detailed description, see Report of this Station for 1917, page 317, where Busck's original description is reproduced.

Control Measures.

The ordinary sprays are not very effective in controlling the Oriental peach moth, though may somewhat reduce the percentage of injury. Garman reports the most success with a spray of self-boiled lime-sulphur, to which calcium arsenate and tobacco had been added, following a winter spray of lime-sulphur. Nicotine solution and soap did not decrease the infestations over the check or untreated trees.

The Federal Entomologists experimented with various spray mixtures but found none that gave positive results in controlling the pest. Likewise fumigation with hydrocyanic acid gas failed to kill

larvae in gummy peach twigs or in their winter cocoons on nursery stock. Clipping off and destroying the twigs gave only a partial measure of control and was too laborious to be practicable. Dipping in miscible oils, even as concentrated as one part in ten parts of water, did not kill the larva.

Thus it appears that the Oriental peach moth is a most difficult pest to control and it is to be hoped that the parasites may soon reduce its numbers to the minimum.



Figure 9. Oriental peach moth, enlarged about ten times. (After Wood and Selkregg, Bureau of Entomology, U. S. Dept. of Agriculture.)

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THE PEACH TWIG BORER.

Anarsia lineatella Zell.

In the work of Mr. E. D. Brown in searching for the Oriental peach moth *Laspeyresia molesta* Busck. in Connecticut, our attention was called to the presence of the peach twig borer in an extent not before realized. Reference has already been made to this insect on page 299, and how the larva may be distinguished from that of the Oriental peach moth, but a more comprehensive account is given here for the information of the fruit growers of the state, who more than ever before will notice the borers in the twigs of their trees. This insect occurs in Europe and since 1860 has become distributed throughout the United States and Canada where peaches are grown. Though it is occasionally troublesome in the Eastern states it is on the Pacific coast where it does the most damage, causing a loss of twenty-five per cent. of the crop in certain regions.

In searching for the Oriental peach moth, the field agents of the Bureau of Entomology found the peach twig borer present in Connecticut, New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, Ohio, Oklahoma, but strange to say did not obtain it in California or elsewhere on the Pacific coast where it is reported as doing the most damage.

The life-history of the peach twig borer is very similar to that of the Oriental peach moth: it hibernates in the larval stage: there are four broods each season: the over-wintering larvae tunnel in the new growth: the larvae of later broods infest the fruit: its attacks are not confined to peach alone but plum, apple and pear are sometimes injured. It is the stone fruits, however, that are usually attacked.

The peach twig borer has a brown larva which may be readily distinguished from the pinkish-white larva of the Oriental peach moth.

Distribution in Connecticut.

Our records show that during 1918, the peach twig borer was taken by Mr. Brown in Stamford, Norwalk, Wallingford and Old Lyme. There were many cases of twig injury in the towns of Greenwich, Stamford, Darien, New Canaan, Norwalk, Westport, Fairfield, Stratford, Milford, Orange, New Haven, Branford, Guilford, Madison, Seymour, Woodbridge, Cheshire, North Haven, Meriden, Wallingford, Clinton, Westbrook, Old Saybrook, Essex, Saybrook, Chester, Old Lyme, Lyme, East Lyme, and New London which may have been caused either by the peach twig borer or by the Oriental peach moth, as it is impossible to distinguish the work of one from the other when specimens of the insect are not present. The data obtained indicate that both insects are more common along the coast than inland as no twig injury was observed at the points visited in Danbury, Bethel, Wilton, Trumbull, Hartford, East Hartford, Manchester, Southington, Middlefield, Middletown, Haddam, Groton, Ledyard and East Hampton.

Injury to Twigs and Fruit.

The over-wintering larvae tunnel into the new shoots in spring causing them to die. A tree badly infested looks as though it had been scorched by fire. The larvae of later broods also burrow in the twigs of the new growth, but soon attack the fruit, especially of late varieties late in the season. Smith* states that in New Jersey, "the larva has been recorded in woody excresences of plum, peach and apple and in stems of strawberry. I have seen it only boring in the tips of peach twigs; but not in destructive numbers." The larvae after burrowing in the shoots leave their twigs and attack others, thus causing considerable injury and Slingerland and Crosby** claim that "three or four larvae have been known to kill a three-year-old peach tree by destroying all the new growth."

According to Marlatt† the peach twig borer is considered one of the three or four worst insect pests of California, and that it is very destructive to peach, plum, apricot, and almond in western Colorado. In addition to the fruits mentioned it also attacks nectarine, prune and pear on the Pacific slope.

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* Insects of New Jersey, page 560, 1909.

** Manual of Fruit Insects, page 285, 1914.

† Farmer's Bulletin, No. 80, page 3, U. S. Dept. of Agriculture, 1898.

Early in June the larva attacks the fruit usually near the stem, and eats a cavity in the flesh often close to the pit. The excavation usually becomes filled with gum and excrement. Subsequent broods injure the fruit also, often doing much damage.

Life History.

The larva hibernates in a small silk-lined cavity in the bark at the base of a new shoot. The position of the hibernating cavity is indicated by the particles of bark webbed together forming small reddish-brown mounds in the crotch as shown in figure 10. This

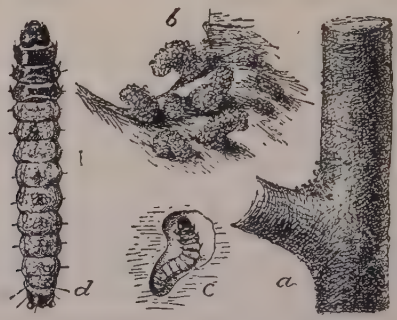


Figure 10. Peach twig borer: *a*, peach twig showing masses of chewed bark in crotch above larval chambers; *b*, same greatly enlarged; *c*, larva in its cell, enlarged; *d*, larva, greatly enlarged. (After Marlatt, Bureau of Entomology, U. S. Dept. of Agriculture.)

cavity is enlarged by the larva feeding in spring, but as soon as the new growth starts, the larva attacks successively several of the new shoots, burrowing into the pith. These shoots soon wither and die. When fully grown the larvae make loose silken cocoons between the upturned edges of the outer bark, and pupate. Ten to twelve days later the adult moths emerge, and the females lay their eggs on the bark of the new shoots at the base of the leaves. These eggs hatch in ten days, and the larvae attack the new shoots and later the fruit. The second brood larvae reach maturity in July or August and make their cocoons in the cavity at the stem end of the peach. The second brood of moths lay their eggs on the fruit and the larvae hatching from them feed in the fruit. There are four broods each season, and the later broods feed chiefly in the fruit.

Description.

Egg. About 4 mm. long, 2 mm. thick, ovoid, white, turning to orange, fastened lightly lengthwise to the twig. Under the microscope the surface appears reticulated.

Larva. 10 to 12 mm. (half an inch) long, rather stout, tapering strongly toward either extremity, dull reddish-brown; head and cervical shield dark brown or black. Lighter spaces or rings are noticeable between the segments. Ventral surface lighter. Hairs rather long and borne singly from small tubercles.

Pupa. 6 to 7 mm. long, rather robust, brown, fastened by a few threads to bark, shriveled leaves or rubbish.



Figure 11. Peach twig borer: *a*, new growth withering from attack of larva; *b*, larva, about three times enlarged; *c*, pupa, about four times enlarged; *d*, tip of pupa, side view, much enlarged. (After Marlatt, Bureau of Entomology, U. S. Dept. of Agriculture.)

Adult: Wing-expanse about 12 mm. (half an inch) steel gray with darker spots on forewings. Wings narrow and the rear margin of the hind wings and tips of forewings are heavily fringed with gray.

The adult is shown on plate XXX, a, and the larva in figure 11.

Methods of Control.

In California and other places where extensive tests have been made, experience shows that the peach twig borer may be controlled by spraying with lime-sulphur or miscible oils in late spring just after the buds begin to swell. The treatment may be kept up until the first blossoms appear.

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LIFE HISTORY AND DEVELOPMENT OF THE GREENHOUSE COCKROACH.

Pycnoscelus surinamensis Linn.

By M. P. Zappe.

In the Report of this Station for 1917, pages 302-315, was published an account of this insect, its distribution, synonymy, injury, description of adult and egg, egg-laying habits, literature and the control methods tested in a Connecticut greenhouse.

As there appeared to be no descriptions of immature stages, and nothing in literature concerning the life history of this species, an attempt was made to follow its development under laboratory conditions, from the egg to the adult stage. The following notes, therefore, are the results of these observations:

Effect of Temperature.

It was noticed in the greenhouses where this roach was doing damage that the greatest numbers were found in the houses immediately adjoining the heating plant. They were also numerous in a house just above the boilers. In the rose houses where they were more plentiful than anywhere else the temperature was always kept between 70° and 80° F. during the day and at night was never allowed to get below 60° F.

In November 1917, a large number of living roaches were collected and were taken back to the laboratory for study. At that time there was no heat in the laboratory for a few weeks and some of the coldest days the temperature went down to between 36° and 40° F. This cold lasted for nearly a week and about 95 per cent.

of the roaches died and the others seemed to be dead but when removed to another room where the temperature was about 65° F. a few of them showed signs of life, finally revived and lived for some time afterward.

Five adult roaches were exposed to a temperature of 30° F. for an hour and appeared to be dead but when returned to normal room temperature they all came back to life in about 20 minutes. Another lot was exposed for 2 hours to a slowly rising temperature from 30° to 36° F. They all survived this treatment but when exposed overnight for about 15 hours at a temperature of 24° F. they all died.

Another lot of roaches was exposed to a temperature of 1° F. for only 10 minutes which proved fatal to them all.

This species of roach like some of the other species, likes moisture; in fact it must have a certain amount of moisture in order to live. In the laboratory roaches which were kept in test tubes, dry sand and dry boxes usually died in a few days. It became necessary to keep a moistened blotter in each cage or else add a little water to the sand in the cage where they were confined.

Natural Enemies.

With the exception of a mite which caused the death of quite a number of the roaches in our study cages no parasites of this species have been seen in Connecticut.

Life History.

There are six moults from egg to winged or adult stage. The time required to cover this period varies quite a little with different individuals. Out of a brood of young from the same mother, in the same cage, with all conditions of temperature, moisture, food, etc., the same, the time varies six or seven weeks. The average length of time to reach the adult stage is about seven and one-half months. It takes from fifty to one hundred days from the time it reaches the winged or adult stage for an adult roach to produce a brood of young. This makes the total time from one generation to another approximately ten months.

Moults.

First instar. Very young nymphs only a few hours old. Length about 3 mm., width 1 mm. Color whitish, eyes, mandibles and tarsal joints brown, rest of nymph turns light brown after several hours.

SECOND INSTAR. Length 5 mm., width 2 mm. Color light brown, head and thorax darker than the abdominal segments. Body above shiny. There are eight abdominal segments, the distal five of which are not so shiny as, and a little darker than, the other three segments. Antennae same color as body, except basal and two distal joints which are lighter colored. Under side of body including legs, tarsi, labrum and palpi much lighter than the rest of body.

THIRD INSTAR. Length 6 mm., width 3.5 mm. Color much darker, almost black, shiny, last five abdominal segments not so shiny. Last thoracic segment covers ends of first abdominal segment and about one-half of the second segment. Under side of body much lighter than rest of body. Tibiae and tarsi lighter than underside of body.

FOURTH INSTAR. Length 10 mm., width 6 mm. across abdomen which is the widest part of body. Color a little darker than in previous moult. Abdomen much broader in comparison with head and thorax than in last moult.

FIFTH INSTAR. Length 18 mm., width 9 mm. Color same as in last intar. Last five segments of antennae lighter than others.

SIXTH INSTAR. Length 20 mm., width 8 mm. Color same as in last two instars. Roach not so flattened, more convex than in other moults. Much longer and not so wide as in previous instars.

SEVENTH INSTAR. Adult winged stage. (For description see Report of this Station for 1917, page 306.)

OCCURRENCE OF THE EUROPEAN HOUSE CRICKET IN CONNECTICUT.

Gryllus domesticus Linn.

By M. P. ZAPPE.

This insect often called "the cricket on the hearth" was reported from Shelton, in July, 1918, where it was living in the attic of a new house and annoying the occupants by its nightly chirping and by getting into the food in the pantry on the floor below.

The complaint was investigated, July 29th, by the writer. There were great numbers of crickets in the attic, with considerable old clothing stored there, some of which had been eaten into by the crickets. During the day they were in hiding and comfortably quiet, but at night they chirped incessantly making considerable noise. There were two rooms in the attic, one of which was used as a sleeping room. The other was used as a sort of store room. At the time of the writer's first visit, there was a crookneck squash in

this storage room which had its entire inside, seeds, pulp and all eaten out by the crickets. A great number of them were hiding between the rafters, roof boards and shingles. They were gnawing into the wood and the floor was covered with bits of chewed wood.

At night they came downstairs and got into the pantry where they ate into all sorts of food that they could get at. They seemed to be particularly fond of bananas. A few could be found in the daytime in the drawers in the pantry, in the flour, etc., and were as much of a pest as cockroaches. The amount of food actually eaten was not so great as that soiled by them and thus rendered unfit for use.

It is hard to understand just where these crickets came from, unless they had been present in the office of a large garage next door, and from there had entered this residence. None of the other houses in the immediate neighborhood had been troubled with this pest.

Distribution.

This species is common in most all of the European countries and it is also present in Asia, Africa and Australia. In Spain it is a source of pleasure often being kept in cages much like we keep canary birds. Its first introduction into America was probably at an early date, at least in portions of the country. Kalm, writing of this insect in 1749 says "it is abundant in Canada especially in the country where these disagreeable guests lodge in the chimneys; nor are they uncommon in the towns. They stay here both summer and winter and frequently cut clothes to pieces for pastime."* The year before, however, he writes that he had not met with them in the houses in Pennsylvania or New Jersey.

In the United States it occurs sparingly in practically every state east of the Rocky Mountains.

Habits.

The house cricket usually occurs on the ground floor of dwellings and evinces its liking for warmth by often occurring in the vicinity of fireplaces, concealing itself between the bricks of the chimney or behind baseboards, frequently burrowing into the mortar of walls. It is rarely abundant but at times multiplies excessively and be-

* Travels Vol. I, page 318: II page 256.

comes a very serious menace. During the winter it remains torpid but under the influence of warmth becomes active and musical.

It is mainly nocturnal in its habits coming out at dusk and roaming around the house for whatever food materials it may discover. It will often cut and injure fabrics and is particularly apt to cut into wet clothing evidently on account of its liking for moisture. The common field crickets are apt to get into houses and try their jaws on all sorts of clothing particularly woolens. Dr. Lintner* records the case of a suit of clothes just received from the tailor which was completely ruined in a night by common field crickets.

There is a popular superstition also to the effect that if a cricket be killed its relatives will promptly cut the garments of the offender.

In Europe and undoubtedly also in this country the hearth cricket is found in houses in all sizes from the very young to the full-grown insects, and probably often deposits its eggs and goes through its entire transformations within houses. During the summer it also appears frequently out of doors in Europe about hedges and in gardens returning to the house for protection on the approach of cold weather and being apparently unable to winter out of doors at least in cold climates. In this country it has been taken out of doors at electric lights. Its eggs judging from our knowledge of allied species are deposited in clusters and the young resemble their parents closely except in size and in lacking wings; they present also no variation in habit.

Description.

The adult is pale yellowish brown or straw-color with reddish brown markings on head and pronotum. Tegmina reaching nearly or quite to the tip of the abdomen, sometimes with reddish brown spots on their basal third. Inner wings either abbreviated or extending considerably beyond the ends of tegmina. Hind femora short and slender. Ovipositor about one and one-fifth times the length of the hind femora, pale brown becoming darker towards the tip. Both sexes are shown on plate XXXIII, c.

Control Measures.

On July 29, two kinds of poisoned bait were tried as follows: (1) Potato flour which had been soiled by the crickets, ½ pound; Borax, ½ pound; one mashed ripe banana. This was all mixed together and enough water added to make a thin paste.

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* 8th Report Ins. N. Y., page 179.

(2) Bicloride of mercury, one tablet dissolved in ½ cupful of water; this was added to a cupful of flour. The skin of a banana was cut up into small pieces and put into the bait.

Two days later, on July 31st, the house was visited again and all the poisoned bait had been eaten. A great many of the crickets had been killed, but there were still a few alive. As all the bait was eaten it was hard to tell which of the two baits was the most effective. The treatment was continued until August 9th. Then the lady of the house reported all the crickets gone, that she had neither seen nor heard any for a few days and it was safe to assume that they were all dead.

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THE EUROPEAN CORN BORER. A DANGEROUS INSECT WHICH MAY OCCUR IN CONNECTICUT.*

Pyrausta nubilalis Hbn.

On September 6, the writer attended a conference of entomologists at Boston to discuss methods of controlling the European corn borer *Pyrausta nubilalis* Hbn., an insect formerly known in Europe as *Botys silacealis*, which was discovered in 1917 infesting corn in the vicinity of Boston. Each of the New England States and New York were represented, and several representatives of the Bureau of Entomology were present including the Chief, Dr. L. O. Howard. Though the conference had been called for 10 o'clock, A. M., the meeting was postponed until after luncheon, in order to first make a field trip to see some of the damage caused by this insect. Con-

* Since this was put in type, borers have been found in corn stalks, in Milford, which may prove to be this pest.

sequently we were taken in automobiles to a field of sweet corn in the town of Winchester, where the plants were seriously infested. Here on a truck farm a small field of corn surrounded by celery and other vegetable crops, afforded an excellent object lesson of what enormous injury might result in case this pest should spread to the large corn growing sections of the country.

The tassels were nearly all broken over and this is said to be the first noticeable sign of infestation. In the axil of nearly every leaf there was a heap of "sawdust" or "borings" as large as the end of one's finger. Larvae of various sizes were present tunnelling in the stalks and ears, some being nearly full grown and others not more than half-grown. Some were feeding at the tip of the ear like the corn ear worm *Heliothis obsoleta* Fabr., and others were boring in the stem of the ear or perhaps in the cob. There must have been several larvae somewhere at work in each stalk and many larvae in some stalks. It seemed as if every stalk was infested.

Mr. Donald J. Caffrey of the Bureau of Entomology who had been working on this insect for a greater part of the summer, and Mr. Stuart C. Vinal of the Massachusetts Agricultural Experiment Station who has been at work on the life history and habits of this insect for the last two seasons were both present and explained the habits of the larvae, and the injury caused by them. It seems that the small larvae begin work in the stem of the tassels when the latter are just beginning to show above the leaves. Many of the mature tassels were broken and had fallen over, the break sometimes occurring mid-way, and again near the tip or at the base. This falling over of the tassel or a portion of it is noticeable a short distance from the field and according to Mr. Caffrey is often the first indication that the crop is infested. Some of the small larvae may also bore into the mid-ribs of the leaves. As the larvae increase in size they abandon the smaller stems and tunnel in the larger stalks. Sometimes there are several larvae in the same stalk and sometimes one larva may leave its burrow and attack consecutively several different plants.

Not only was the corn attacked, but the pest is not confined to corn, as many of the weeds in the cornfield and particularly around its margins, were infested. We, therefore, saw barn yard grass *Echinochloa crus-galli* Linn., lamb's quarters, *Chenopodium album* Linn., red root pigweed *Amarantus retroflexus* Linn., with heaps of sawdust thrown out of the burrows and the larvae inside. This sit-

uation of course greatly complicates the question of eradication or control.

So far as known this insect works in all portions of the plant except the small fibrous roots. It occasionally tunnels downward in the main stem below ground, and Mr. Caffrey believes that it may attack any part of the corn plant above the surface of the ground.

At the conference at the State House in the afternoon, various phases of the problem were discussed, and from this conference and in conversation with the entomologists at work on the problem and from Bulletin 178 of the Massachusetts Agricultural Experiment Station, by Stuart C. Vinal, the following facts have been obtained, and are given here in order to call attention to this very destructive insect, which may at any time be found in Connecticut.

The European corn borer was reported as having been observed in Connecticut near Putnam in the fall of 1917, but on investigating the matter no traces of it could be found, and it is probable that the insect noticed was the stalk borer *Papaipema nitela* Guen. or the corn ear worm *Heliothis obsoleta* Fabr., both of which are common and occur all over the state.

Injury.

According to Mr. Vinal* the young larvae at first feed upon the unopened staminate flowers but soon leave these buds and tunnel in the tassel stem as has been mentioned, thus causing the tassel to break and fall over. No doubt this would have the effect of destroying or greatly reducing the pollen and thus affect the crop. Larvae also enter the sheath surrounding an internode, and feed on the inside of the sheath, later boring into the pith of the stalk where it excavates quite a large cavity. Such injury is usually confined to that particular internode; though sometimes the larva bores through a node, it usually turns backwards and tunnels in the same internode but in the opposite direction. Where several larvae are at work in a stalk, it soon becomes tunnelled to such an extent that it breaks over in the wind. Some of these boring larvae find their way into the pedicel or small stalk bearing the ear, causing it to droop and die before maturity; frequently one of these borers goes on into the ear or cob.

*Bull. 178, Mass. Agr. Expt. Station

Probably the most serious damage to the crop results from the attacks of the larvae of the second brood, a large percentage of which go into the ear immediately after hatching. Here they injure the ear much like the corn ear worm, and in addition to feeding upon the kernels they tunnel into or through the cob. In Massachusetts in 1918, 311 larvae were collected from one hill of corn. In Hungary in 1898, this insect is said to have destroyed one-fourth or 25 per cent. of the entire crop of field corn but the injury is estimated to be 90 or even 100 per cent. of the total crop in some parts of Russia. The first brood attack early sweet corn, but later in the season both broods attack the later corn and here the most serious injury occurs. Late in the season in Massachusetts the larvae went

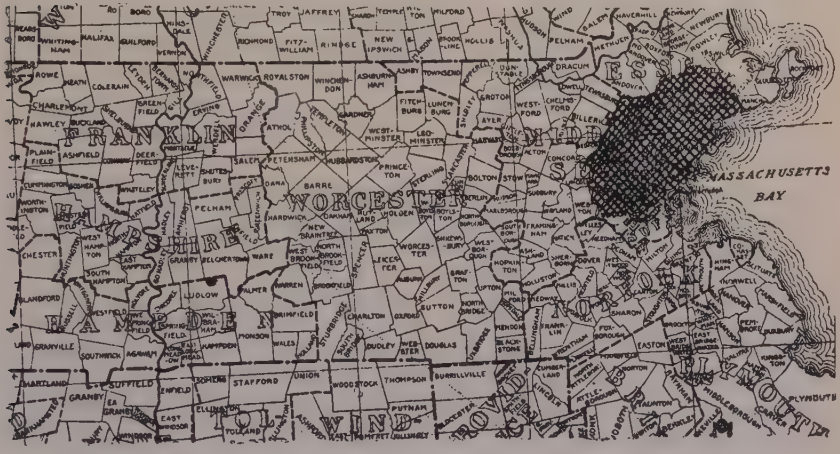


Figure 12. Map of Eastern Massachusetts, showing area (shaded) now occupied by the European corn borer.

from the corn into nearby celery, causing great damage as in some cases there were eight larvae in a stalk or 46 per plant.

Distribution.

The European corn borer is known to occur in Central and Northern Asia and Japan, the Southern and Central portions of Europe and in Egypt. In the United States, this insect is not known to be present except in one locality, in the eastern part of Massachusetts. The area infested includes 34 towns, extends only slightly south of Boston, a few miles westward, and perhaps twenty miles toward the north, approximating about 320 square miles including cities and waterways, and is shown in figure 12.

Though discovered in Massachusetts in 1917 by Mr. S. C. Vinal, sweet corn grown in gardens ten to twelve miles inland had been attacked for the past three or four years. Mr. Vinal* concludes that the pest must have been brought to this country about 1910, probably in hemp imported by one of the cordage firms in the vicinity of Boston.

Food Plants.

Though corn or maize is the chief commercial crop attacked and injured in this country, the insect attacks a number of other plants including garden vegetables and the larger common weeds. Sweet corn is the crop most seriously injured. As a rule the moths will not lay eggs on the other plants if corn is available. The newly-hatched larvae may easily be blown upon any adjacent plants and will feed in some of them. In Europe besides maize, hops, hemp, cotton and millet are injured.

In Massachusetts according to Mr. Vinal the following plants have been attacked by *Pyrausta nubilalis:*

Corn *Zea mays* Linn. Celery *Apium graveolens* Linn. Barnyard grass *Echinochloa crus-galli* (L.) Beauv. Fox-tail grass *Setaria glauca* Beauv. Millet *Setaria italica* Kunth. Dock *Rumex* sp. Burdock *Arctium Lappa* Linn. Lamb's quarters *Chenopodium album* Linn. Red root pigweed *Amarantus retroflexus* Linn. Beet and Swiss Chard *Beta vulgaris* Linn. Tomato *Lycopersicum esculentum* Mill. Potato *Solanum tuberosum* Linn. Spinach *Spinacia oleracea* Mill. Ragweed *Ambrosia artemisiaefolia* Linn. Ladies' thumb *Polygomum persicaria* Linn. Dahlia *Dahlia variabilis* Desf. Chrysanthemum. Gladiolus *Gladiolus sp.* Bean *Phaseolus* sp. Bur Marigold *Bidens frondosa* Linn.

Habits and Life History.

No definite report on life history studies in this country are at hand, though Mr. S. C. Vinal was at work on the matter at the time of his death in September, 1918, and the results of his studies will probably be published in due time.

Apparantly the nearly mature larva passes the winter in the corn stalks, and pupation occurs within the burrow in the spring. The adults emerge probably the latter part of May. The females begin laying eggs on the corn stalks a short time after, and these eggs hatch in a few days. The young larvae feed upon the leaves and soon eat their way through the sheath, and tunnel in the main stalk. They

* Bull. 178, Mass. Agr. Expt. Station.

reach maturity the latter part of July and each excavates an opening to the burrow for the adult to escape, spins a silken partition above and below and pupates. In about two weeks the moths emerge and lay eggs for the second brood of larvae, which as a rule do not transform but hibernate as nearly mature larvae. There were indications of at least a partial third brood in Massachusetts in 1918.

The larvae will leave one plant and attack another.

Though the larvae usually pupate in their burrows, they will sometimes make this transformation in packing boxes, especially in the spring.

The adults are not especially attracted to lights.

Pyrausta nubilalis is not strongly parasitized either in Europe or in Massachusetts though Kostinsky* mentions that both Hymenopterous and Dipterous parasites were present on one estate in the Government of Kiev, Russia, in 1915. Averin** states that only a small number of larvae and pupae perished from the attacks of parasites and fungous disease in the Government of Charkov, Russia, in 1914.

Mr. Vinal stated at the conference that the percentage of parasitism in Massachusetts was found to be very small, only 15 out of 600 being parasitized. Of the parasites reared, there were four species of Tachinid flies (Diptera) and one (possibly two) of Hymenoptera.

Description.

The mature larva is about an inch long, flesh-colored, often somewhat smoky or reddish dorsally. Head dark-brown and flat. Each abdominal segment bears a transverse row of four dark colored spots, each spot surrounding a short stout spine. Just back of this row of spots are two smaller spots, one on each side, and a short distance from the median line.

The adults have a wing-expanse of about an inch in the male to an inch and a quarter in the female. The sexes differ greatly in color and markings and might easily be thought to be different species. The adults were described (though not originally) eighty years ago by Kollar, in his Treatise on Insects Injurious to Gardeners, Foresters and Farmers, the English edition of which was published in 1840, page 108. Except for the mention of the female

* Review of Applied Entomology, Series A, Vol. IV, page 208, 1916.

** Ibid, Vol. II, page 442, 1914.

being more rare than the male, a point about which I have no information, this description will serve to identify the species and is given here:

MALE. "The ground colour of the head, back, and anterior wings is brownish-grey, varying into purplish; on which yellow ochre-colored spots and markings appear in patches. The antennae and palpi are grey, the former serrated, the latter short, porrected (elongated), and pointed. The shoulders are generally light yellow ochre. The abdomen is grey, with whitish rings, the anal tuft brown mixed with grey. On the fore wings there is usually, but not always, an indistinct yellow, notched, transverse line, followed in the middle of the wings by a longish, cornered, yellow spot, and a second transverse line, very wavy, and more or less flowing into the veins. There are many yellow dust-like spots just above the grey fringes. The under wings are fainter; they have an imperfect, broad, yellowish-white band, which sometimes only looks like a large middle spot.

"The under side of all the wings is throughout dull brown, the markings on the upper side form a pale yellow band, and a middle spot of the same colour bordered with dark brown.

FEMALE. "Much rarer than the male, the yellow ochre is spread over its back and the whole of its upper wings; the transverse lines, on the contrary, are light brown; the two central spots are of the same colour. The border above the fringes is notched, watered-brown, and the fringes themselves are yellowish. The under wings have brownish-grey dust-like spots near the base; the broad faint middle band, as well as the border of the fringe, alternate yellowish light grey."

Both sexes, larva, pupa and injured corn stem are shown on plate XXX, b.

MEANS OF SPREAD.

The adults having the power of flight, even though not particularly attracted to lights would naturally extend their occupied territory somewhat each year. The present infested area in Massachusetts probably represents the natural spread of the pest from a single point since the insect was introduced several years ago. As the prevailing summer winds are from the Southwest, we should expect that it would spread further toward the Northeast than in other directions and this seems to the case.

There is great danger, however, that this insect may have been transported in celery, green sweet corn, seed corn on the ear, or in stalks or stover to more distant and widely separated points and that separate infestations may have been started there. The area infested in Massachusetts is a truck or vegetable growing center and green sweet corn is shipped northward, especially to the summer

hotels, in Maine, New Hampshire and Vermont. Larvae carried in this manner might readily emerge from the ears or stems, and enter the stalks of corn growing near by. There is not much shipping of green sweet corn toward the South, but the dried seed may be left on the ear and shipped anywhere, though I am informed that most of the seedsmen obtain their seed corn in shelled condition. Celery is commonly shipped.

Dried corn stalks or stover is used chiefly as fodder and not shipped very great distances, but according to Mr. Caffrey it is used to a limited extent as a packing material for heavy pottery, stone and glass ware, and of course may be sent anywhere and any distance. As the larvae hibernate in their burrows and often pupate there or in the crevices of packing boxes, there is great danger of the pest being transported in this way.

Quarantines.

On account of the possible danger of transporting this insect in ears of sweet corn, seed corn, or in corn stover the following quarantine was established:

State of Connecticut.
Office of
Agricultural Experiment Station,
New Haven, Conn.

September 20, 1918.

Whereas a very destructive insect known as the European Corn Borer *Pyrausta nubilalis* Hubner exists in the State of Massachusetts and threatens the corn growing industry of the country; and

Whereas there is great danger that this insect may be brought into this state by transportation of corn on the ear or parts of the plant containing the larvae or pupae from said State of Massachusetts into this State;

Therefore pursuant to the provisions of Section 2106 of the General Statutes it is hereby ordered that no corn on the ear, stover, or other parts of the corn plant (except the shelled dry kernels or cooked and preserved products or corn grown in other states passing through the State of Massachusetts in transit) shall be transported or moved or brought from the State of Massachusetts into the State of Connecticut, unless written permission therefor be first obtained

from the Director of the Connecticut Agricultural Experiment Station, which permission shall accompany each shipment.

This order shall take effect from its date.

E. H. JENKINS,
Director Conn. Agricultural Experiment Station.

Approved:
M. H. HOLCOMB,
Governor.

At the time of this writing the State of Vermont has issued similar regulations and the Federal Horticultural Board has placed a quarantine against the infested towns of Massachusetts. It is evident that these quarantines should be modified to include celery.

CONTROL MEASURES.

From the fact that the insect passes its larval and pupal stages entirely within the plant, it is evident that it must be controlled in some way other than by the use of insecticides. The best chance for control seems to be along the lines of cultural practice, the most important points being the disposal of the stalks and the destruction of the stubble, weeds and rubbish around the field which serve as a hibernating place for the larvae. These methods will not prove very effective unless carried out by every grower in the infested region. Hence cooperation is desirable and necessary in the control of this pest.

Disposal of Infested Stalks—Where the stalks are cut into short pieces and packed in the silo and there undergo fermentation, there is little chance that any individual can escape death. Probably few borers will escape if the green corn is fed to cattle or to hogs. The dry stalks or stover will not all be eaten by cattle unless cut up or shredded, but if this is done and and not too great a quantity is given at one time, it will be eaten and all insects destroyed. Where there are no cattle or hogs kept on the premises the stalks may be burned, buried under a foot or more of soil, or composted with plenty of manure and there should not be much danger of the borers emerging the following season. It should be borne in mind that the stubble also should be plowed under deeply, or dug out and gathered and buried or burned.

Destruction of Weeds and Rubbish—In the control of this insect it is extremely important to keep the field absolutely free from weeds, especially those which are attacked. This applies not only to the cultivated portion where the crop is grown, but also to the margins and uncultivated land adjoining. If such plants are allowed to grow they should be destroyed by gathering and burning, or by feeding to the hogs or composting them with manure in order to kill the larvae in them. The same treatment should be given the stalks of potato, tomato, bean or any other cultivated plants which grow near the corn and thereby become infested.

Probably it is only by the most persistent, thorough and universal practice of these methods that the European corn borer can be satisfactorily controlled.

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THE BEAN LEAF BEETLE.

Cerotoma trifurcata Forst.

In 1918, for the first time in many years the bean leaf beetle was reported as injuring beans in Connecticut. The writer observed this damage to string beans on May 29, in a garden at 1108 Whalley Avenue in New Haven. Though not very abundant, beetles could be found here and there feeding on the leaves, and a part of one row had most of the leaves perforated and ragged.

On June 2, the writer found these beetles at work on string beans in his own garden, though not sufficiently abundant to render spraying necessary. On June 11, they had increased somewhat in numbers, and there was evidence of moderate feeding upon the leaves which were injured as shown on plate XXXI, d.

This insect occurs throughout the eastern half of the United States and feeds normally upon native leguminous plants such as

bush clover or *Lespedeza,* tick trefoil or *Meibomia,* and hog peanut or *Amphicarpæa.* The adults feed upon the leaves of these plants and the larvae feed upon the roots or stems below the surface of the ground. It has also been recorded as feeding upon the leaves of cowpeas, soy beans and English horse beans. McConnell* records an unique form of injury to cowpeas, wherein the larvae devoured the nodules on the roots, thus destroying the organisms which enable the plant to obtain nitrogen from the air. The chief damage occurs in the Gulf States, but in certain seasons considerable injury results from its attacks further north. Injury to foliage has been reported from Indiana, Ohio. New Jersey, Delaware, Maryland and Virginia. *Cerotoma trifurcata* is a native American species which occurs from Canada southward to the Gulf of Mexico, and as far westward as Minnesota and Kansas. The Station collections contains adult beetles from New Haven, Hamden, Branford, and Windsor: no doubt the species occurs throughout the state.

The adult beetle shown on plate XXXI, c, is about 5 mm. in length, and varies in color from pale buff to dull red with black markings which vary greatly, the typical form having two large, more or less rectangular spots half-way and close to the inner margins of the wing-covers; a triangular spot at the base and a smaller one at the apex, both close to the inner margin; the outer lateral margin is bordered by a black band, which does not quite reach the apical spot. Head black, thorax buff, without markings. Antennal joints buff, tipped with black. Legs buff, with tips of middle and rear femora, and middle and rear tibiae, black.

This species is subject to great variation, specimens being found without black markings, while others have the markings confluent giving them a decidedly dark appearance.

The beetles appear as early as April in the South but in the North they do not attack the beans until June. They are usually found on the under side of the leaves and though their injury may be seen, on account of their position they often escape notice.

The eggs are oval, orange in color and are laid in the soil around and rather near the stem of the food plant in clusters of six or more.

Where only a few beetles are present, hand picking may be practiced, or insect powder may be dusted upon the leaves, but in case

* Journal of Economic Entomology, Vol. 8, page 261, 1915.

of a severe infestation, the foliage should be sprayed with lead arsenate, one ounce of the paste or one-half ounce of the dry powder in one gallon of water. Lead arsenate of course, should not be applied to string beans if the pods are nearly ready to harvest. As a rule the injury appears long before the pods are large enough, and in fact usually before the beans blossom. Where the beans are to be shelled and the pods discarded, there is no danger from the use of lead arsenate.

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INJURY BY THE RASPBERRY SAWFLY.

Monophadnoides rubi Harris.

On May 29, 1918, the Entomologist was called to examine a field of red raspberries, containing about an acre, on Osborn Avenue, north of Dyer St., New Haven. This field is situated on a knoll and slopes toward the north and east. Nearly all the leaves had been riddled by the green spiny larvae which were very abundant, nine being counted on a single leaf. Most of the larvae were nearly mature, consequently the damage had been done. Practically all of the older leaves had been eaten, but the new and tender shoots were uninjured. The owner who had just discovered the injury had attributed it to the small brown beetles, *Byturus unicolor* Say, which were also rather abundant on plants in certain parts of the field. As the owner desired to prevent any further damage he was advised to spray the field with lead arsenate, using two pounds of the paste in 50 gallons of water. The spraying was done immediately with a power sprayer but the season's crop had already been seriously injured.

Considerable material was gathered and brought to the laboratory, and on June 4, all larvae had gone into the ground to pupate.

The larvae are dark green, matching very closely the tint of the upper side of the leaf, covered with tubercles bearing lighter green forked spines, which are about the same color as the under surface of the leaf. Though the larvae usually feed upon the upper side, on account of the close resemblance in coloration they often escape notice, especially where the leaves have been riddled so that they show in shreds of both light green and dark green.

This insect has been observed and collected a number of times in Connecticut and was mentioned in the Report of this Station for 1908, page 846.

The raspberry sawfly appears to be a native American species, which has been mentioned in literature occasionally since the publication of Harris' "Entomological Correspondence" in 1846. It occurs in the Northern States and Canada from the Atlantic Seaboard as far westward as Iowa. In Connecticut, this insect has been collected or observed at New Haven, North Haven, Branford, and Stonington and doubtless occurs throughout the State.

The eggs are laid by the females on the under surface of the leaves usually near the mid-rib or the larger veins. Sometimes like those of the currant worm, they are placed in a row along the mid-rib but more often the female makes an incision and deposits the egg in the tissues of the leaf, between the two outer epidermal layers. The egg is white, oval in form, and less than one millimeter in length. The leaf tissue over each egg becomes dry and turns yellow giving the leaf a spotted appearance, which is quite characteristic of the attacks of this insect. At the end of a period varying from seven to ten days after being laid, the eggs hatch and the young larvae begin to feed upon the leaves, at first eating only the epidermal layer, but as they become larger they are able to eat entirely through the leaf until finally nothing remains but a net work of veins, as shown on plate XXXII, b.

About ten days is the length of the larval feeding period, when the larvae become mature and enter the ground to pupate. They remain in their pupal cells from June until the following spring and do not actually transform to pupae until March or April. The true pupa stage lasts only a few days and the adults emerge in Connecticut in May.

The full-grown larva is about 18 mm. or three-quarters of an inch long, with body leaf-green with lighter colored spines as shown

on Plate XXXII, a. The adult is a small black sawfly with yellow abdomen. It would not attract notice ordinarily.

There is only one brood each year and treatment by spraying with hellebore or lead arsenate is a simple matter if taken in season. But it is necessary to watch the plants during May because the feeding period is short and the bushes are often stripped before the larvae are known to be present.

All sawfly larvae are easy to kill, and fresh hellebore dusted upon the wet leaves or sprayed upon the leaves when not wet, at the rate of one ounce in two gallons of water, will prove effective.

Lead arsenate may be applied like the hellebore, either as a dry powder sifted or blown upon the leaves when wet with dew, or just after a shower, or it can be applied in the form of a spray. Two pounds of the paste or one pound of the dry powder to 50 gallons of water will be all the poison needed to destroy the larvae.

Lead arsenate should not be used late in the season when the fruit is nearly ready to harvest. If any treatment is needed at that time hellebore should be used. But there is usually no occasion for late applications as the larvae do the damage in Connecticut during the latter part of May. The spraying must be done soon after the plants blossom, and may be done even before they blossom to prevent defoliation.

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THE IRIS ROOT BORER.

Macronoctua onusta Grote.

From time to time the larva of this insect has been sent to the Station, accompanied by reports of injury to Iris beds, tunneling in the rootstocks, but not until 1915, did we succeed in rearing the adult. A brief note regarding the insect was published in the Report of this Station for that year (1915), page 189, and the adult was shown on plate XV, b. In 1918 the Iris Borer was again received and observed, and following a discussion by several correspondents in the Florists' Exchange a brief article was submitted

by the writer and printed in the issue of October 5th, Vol. XLVI, page 531, 1918, of that journal. The following paragraphs are from this article: "An adult in the Station collection was reared from a nearly mature larva collected July 30, 1915. This larva pupated and the adult emerged in October. Mr. A. F. Winn* observed the moth to lay eggs the latter part of September at Westmount, Quebec. in cracks near the base of the leaves of German Iris, and some eggs were deposited between the leaves where the edges overlap. Mr. Winn believes that in nature most of the eggs are laid underneath the edges of these overlapping leaves near the base and that the insect passes the winter in this manner.

"Mr. Henry Bird** of Rye, N. Y., states that the larva bores in the native Iris (*I. versicolor*), the adults emerge in September, and that the larvae are more highly parasitized than other species of Noctuidae which have come under his observation. Apparently Dr. Roland Thaxter† was the first to record the species from *Iris versicolor,* which he found at Kittery, Me. Mr. Arthur Gibson‡ records the rearing of several adults which emerged in September.

"Perhaps the most complete account of this insect which so far has been published, occurs in the 27th Report of the New York State Entomologist, page 52, 1912, by Dr. E. P. Felt. An illustration of the adult appears on plate 17, figure 3, of the report just mentioned. Dr. Felt also published a brief note in the 30th Report, page 71.

"From all of the observations and data gathered, it seems probable that the adults emerge and lay their eggs in the fall and that these eggs hatch the following spring. Of course it is possible that more than one generation occurs in Mr. ——'s latitude, or perhaps the eggs which he has observed as being deposited at the tips of the leaves, are laid by some other species. Here is a chance for careful investigation. It is hoped that some entomologist may be able to carry out such studies with a large amount of material in order to determine the exact facts in regard to the life history of this interesting species. Then we may more intelligently, discuss the subject

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* Canadian Entomologist, Vol. 46, page 296.

** Journal N. Y. Entomological Society, Vol. X, page 215.

† Canadian Entomologist, Vol. 23, page 35.

‡ Ibid, Vol. 36, page 355, and 34th Report Ontario Entomological Society, page 49.

of remedies. In Connecticut, the injury is fairly common but occasional, and only a small amount of material can be found in any single Iris plantation. Most of the larvae which we have secured, fail to produce adults."

In some of the papers mentioned it has been recommended that the Iris leaves be removed and burned or the beds burned over in Spring to destroy the eggs. One of the correspondents of the Florists' Exchange claims that this will do no good because the eggs are laid in early summer, but apparently he is mistaken and has observed the oviposition of some other insect.

Both larva and adult of the Iris Borer are shown on plate XXXIII, a, and b.

GARDEN SLUGS.

Nearly every season inquiries come to the station, sometimes accompanied by specimens of injury to garden or greenhouse plants by slugs. Slugs are not insects though they devour the leaves of plants in much the same manner as insects. They are really mollusks and are closely related to the snails, though not provided with shells. They feed at night often greatly injuring or totally destroying tender foliage, and are especially troublesome around cold frames, greenhouses and in old gardens. Wherever they crawl they leave a trail of slime or mucus which often disfigures the plants, and by means of which they may be traced to their hiding place usually under boards in walks or under rubbish in dark and damp places near the ground. The slugs gnaw large irregular holes in the leaves and sometimes cut off the tender stems in much the same manner as some of the noctuid larvae, especially climbing cutworms: but their injury may be distinguished by the trail of mucus.

Food Plants.

Slugs show a preference for lettuce, but have been recorded on many vegetables, including also celery, parsnip, turnip, carrot, beet, cabbage, onion, leeks, peas, beans, melons, potato, tomato, sweet potato and strawberry. They also feed on violets, ferns, geraniums and doubtless many other plants in garden and greenhouse, and also the common grasses and weeds. They are particularly fond of stored tubers, and cause considerable injury to both potatoes and sweet potatoes when stored in damp cool cellars. Celery when

banked with earth for blanching is often seriously damaged. According to White, slugs are fond of sour milk and raw beef,* and cause much damage to mushrooms grown in pits and cellars.

Life History.

The translucent light yellow eggs are laid in masses of 50 to 100 held together by a light-colored substance usually in damp places underneath flower pots, decaying boards, stones or clods of earth. The young slugs feed upon such materials as may be at hand, and remain four or five weeks together as a colony near the egg mass. They feed at night and remain during the day in a moist dark place.

It is not known just how long a period is required for a slug to reach full development but this probably varies with the species. White† states that in 30 days the young reached a length of an inch in captivity while it takes six months for them to reach a size of about two inches in a heated greenhouse.

It is believed that in winter, slugs go into the ground below the frost line, into pits, cellars, drain pipes, etc.

In heated places like hot beds and greenhouses slugs will continue to breed throughout the winter.

The Spotted Garden Slug.

Though there are three species of slugs found in the United States, the largest species known as the spotted garden slug *Limax maximus* Linn. is the one with which the writer is the most familiar as he has been troubled by it in the cold frame, where lettuce and various other seedling plants were injured. This slug has been known to reach a length of seven inches, when fully extended but, the specimens which commonly are seen are usually three or four inches long or less. The younger forms are a uniform gray in color, but the older and larger individuals are distinctly black-spotted. Back of the head is a shield-like covering or mantle and back of this mantle there are three rows of black spots extending to the rear end of the body. When crawling, two fleshy protuberances or horns are extended forward from the head, each bearing a black eye at the tip. This slug is shown in figure 13.

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* Farmer's Bulletin 959, U. S. Department of Agriculture, 1918.

† Ibid.

Control Measures.

The common toad devours slugs but there are said to be few natural enemies.

The application of arsenical poisons to plants is not wholly satisfactory, but may serve to protect the plants, as the slugs seldom feed upon poisoned foliage. On plants to be eaten like lettuce, of course poisoning would be out of the question. Potatoes, baked or boiled, may be poisoned with arsenic and distributed at the rate of one tuber in about two square feet of space in the infested area; some of the slugs will feed upon this bait.

As a rule a bed may be protected by surrounding it with a layer of air-slaked lime but soot, fine coal ashes, road dust, or in fact any inexpensive dry powder will answer the purpose. A sprinkling of common table salt upon one of these slugs will cause almost instant death.

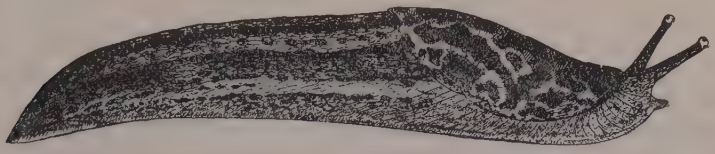


Figure 13. Spotted garden slug, natural size. (After Kingsley, Riverside Natural History.)

Much can be done to control this pest by cleaning up all decaying vegetation around the plants. All plants should be carefully examined and slugs removed before transferring to the greenhouse from the field or frame. All old boards and flower pots should likewise be inspected before they are carried inside.

In greenhouses slugs are often hunted and destroyed at night by means of a lantern or flash light. In the daytime the trail of mucus leads to their hiding places where they can easily be destroyed.

The following account of the habits of slugs is copied from The Riverside Natural History, Vol. I, page 317, and is still of interest:

"The slugs are chiefly nocturnal, and this fact accounts for the few ordinarily seen, although there may be thousands about. In the daytime they secrete themselves under boards, fallen trees, etc., where there is at least partial darkness, but at night they come out to feed. They do a great amount of damage in gardens, as they feed largely on vegetation, although they are not averse to an animal diet. Since they hide

themselves during the day, the damage they occasion is usually attributed to birds, and the larvae of insects, but the presence of slugs can usually be recognized by the presence of streaks of glistening slime in the neighborhood. Most of the terrestrial pulmonates are able to secrete a mucus from their body, and in some there are special pores for its emission. In the slugs this capacity reaches a great development, and as they crawl along they leave a streak behind them, which, on drying, produces the glistening marks referred to. This secretion of mucus is to a certain extent defensive, and when the animals are irritated the amount is greatly increased. This fact gives us a simple method of checking their ravages, which is to sprinkle coal-ashes around the plants which it is desired to protect. The fine grit of the ashes irritates them, and they pour out the mucus to such an extent that they are exhausted, and besides, since it rapidly hardens on exposure to the air, they are soon rendered prisoners.

"This secretion of mucus is used in another way. Slugs frequently climb trees in search of fruit, and when through feeding they take a quicker method of descending than their ordinary snail's pace. The foot pours out a lot of mucus, which is passed along to the posterior end. This mucus is then attached to the limb on which the animal is, and then the slug casts itself loose. Its weight draws the mucus out into a fine thread, and more being secreted, the slug lets itself down after the fashion of a spider, with this exception; it has not the power of returning to the point of support. The power of forming a thread has been observed in almost all the American species, at least when young; but some of the larger forms, when adult, are too heavy to trust their weight to such a slender support.

"We have spoken of their ravages in gardens, but in America they have not yet become such a pest as in Europe. There they are classed along with caterpillars, locusts, and rats, and a war of extermination is waged against them. In olden times the power of the church was invoked against them, but prayers and anathemas failed to cause their extinction, or in fact any appreciable diminution of their numbers. There is another aspect which should not be passed by without mention. Slugs have long been supposed to have medicinal qualities, the rudimentary shell being regarded as especially efficacious. This belief can hardly be regarded as extinct, as Mr. Binney says that "during the year 1863, a syrup of snails was prescribed to members of my family, by two regular French physicians in Paris." During the middle ages, when superstition ran riot, of course they were much more highly esteemed. The shell was regarded as an amulet, protecting the wearer against certain diseases and witchcraft, while the liquid obtained by their distillation was used to improve the complexion. In Europe they are eaten, but in America neither dietetic nor magic qualities have been assigned to these loathsome appearing animals."

MOSQUITO WORK IN 1918.

By B. H. Walden.

In 1918 no new mosquito work was carried out under the law. All of the drainage work which had been approved by the Director of the Station was maintained as provided by the statutes.

One of the most severe storms in years occurred during the fall of 1917 and caused much damage to shore property including the mosquito work. Culverts were washed out, tide gates were damaged and outlets to ditches in many cases were filled up.

Owing to the scarcity and high cost of labor only such work as was considered absolutely necessary was done. The ditches were gone over and all obstructions removed and the ditches cleaned where it was necessary to secure good circulation. Throughout the early part of the season the tides were usually high and produced considerable breeding especially before the first clean-up work was completed, but during the remainder of the season conditions were much more favorable for mosquito control. Had the latter part of the season been wet, however, much additional work would have been necessary to prevent breeding in several sections. These will require special attention next spring.

Early in the spring the selectmen of Madison, Guilford and Branford proposed that they furnish the men for the mosquito work in their respective towns, as they could secure men cheaper than the state could hire them. One reason for this being that the men could be engaged for the season and employed on other town work when not needed for mosquito maintenance whereas the State could only employ them temporarily during practically the same season that there is a special demand for laborers on work which is more desirable than mosquito work. This plan was carried out with more or less success in these three towns, payment for the men's time being made to the town or directly to the men according to the arrangement made.

Madison.

The storm in the fall did considerable damage to the culverts along Madison Beach. The large culvert of West Wharf Road was entirely removed. While this culvert remained in place during the winter of 1917 it did not seem advisable to replace it with one of similar construction or go to the expense of building a more per-

manent structure this season. The outlet was therefore kept open by cleaning out the sand as required during the season. The outer sections of two other culverts were washed away and one at the east end of the beach had the upper end buried by three to four feet of sand deposited on the marsh for a distance of ten or twelve feet. It was necessary to put an additional section on the upper end of the culvert. The ditches on the marshes were maintained in a satisfactory manner.

Guilford.

A proportionately large amount of work had to be done on the Leete Marsh north of Shell Beach. The new outlet ditch as well as some of the old ditches required extensive cleaning. The tide gate at the outlet was damaged by the winter and required repairing. A new tide gate was built on the trolley culvert at the outlet of Great Harbor Marsh. After much delay in securing a contractor to build the gates, they were completed the first week in August. The frame work of the structure was made of 10″ x 12″ and 12″ x 12″ yellow pine with the joints treated with Asphaltum. The two gates 4′ x 4′ are of 2″ cypress plank, double thickness, the outer planks placed vertically and the inner planks horizontally. The gates are hung from the top with specially constructed hinges of heavy strap iron connected with a five inch link or ring. This style of hinge prevents any binding and allows the gates to readily settle into place with the pressure of the water. Above the gates sheathing of 3″ planking extends to above the high water mark.

Branford.

In Branford, a local contractor agreed to furnish laborers for the maintenance work but owing to the prevailing conditions he had trouble in hiring men for his regular work. Several attempts without success were made by the writer to engage men at a reasonable figure. Consequently less work was done in Branford, than in the other towns. The ditches, however, were all gone over and a small amount of extra work was done on the Hotchkiss Grove Marsh and the tide gate at the outlet.

The old tide gates on the Branford River at Hobart's Bridge which were built and maintained by a meadow association were destroyed by the storm in the fall. The Director of the Station was called upon under the State law to build new gates. Estimates

were obtained and it was found that owing to the small amount of money already expended on maintenance work there would be an amount sufficient to build new gates of similar construction as the old ones. There are two bridges across the river, the openings being 28 feet and 18 and one half feet respectively. Four gates were placed on the larger opening and two gates on the smaller. Each gate consists of a frame with single two-inch planking. In order to allow small boats to pass up and down the river the gates are hung from the sides and swing on wooden rollers which set into a mud sill at the bottom and a heavy stringer at the top, and are arranged in such a way that they can be readily removed during the winter. While this style of gate would not be suitable where it is necessary to keep out as much water as possible, it appears to keep out sufficient water in this case to prevent the meadows above from flooding.

East Haven.

The maintenance work on the small ditched area in East Haven was done by Mr. Draper who had charge of the New Haven Work.

New Haven.

Mr. J. W. Draper, who has been employed on the New Haven mosquito work for the past two seasons was engaged during 1918. Additional help was obtained in the spring when the ditches were first cleaned. The large tide gate at the Congress Avenue Bridge on the West River was badly damaged in the fall, and the temporary repairs made by the city were not adequate to prevent the water from flooding the meadows above. The meadows were under water a large part of the time and the vegetation was killed on most of the area up as far as the Chapel St. Bridge. In some cases trees were killed by the flooding. While there was very little mosquito breeding in this area, much damage has been done to the ditches cut in 1917, and the existing conditions have produced one of the most unsightly areas around New Haven. The only solution is to build new tide gates to replace the old ones.

Orange.

The mosquito drainage work in Orange has been cared for by the town, under the direction of Dr. Charles D. Phelps.

Fairfield.

The work in this town was done by Mr. Nicolas Matinck who has been employed on the mosquito work for the past two seasons. Some annoyance from mosquitos, principally fresh water species, was experienced early in the season. This was largely due to favorable breeding condition and the emergence of adults before Mr. Matinck could complete the first clean-up of the extensive area.

ENTOMOLOGICAL FEATURES OF THE SEASON.

Following an extraordinarily severe winter which killed practically all peach buds, except in a few cases along the shore, and almost killed many peach and apple trees in Connecticut, the season of 1918 opened early and there was a fairly good bloom on apple and pear trees. At blossoming time the weather was fair though cold, and there was a good prospect for a set of fruit. Later, however, many growers were much disappointed at the light crop in most sections of the State. In certain localities a good crop was obtained, but generally there was a very light set of fruit, probably due to the absence of bees to pollinate the flowers. At blossoming time, though the weather was clear the temperature was very low, and bees were scarce. Many bees, especially honey bees, winter-killed and were much fewer than normal early in the season. This is probably likewise true of the small native bees of *Andrena, Halictus* and allied genera which ordinarily visit and pollinate the blossoms. On account of the low temperature, those bees which did survive the winter could not work the flowers, and these two factors seem to be responsible for the poor set of fruit.

Apparently the season was fully two weeks ahead of the normal as regards time of bloom, etc., and such seeds and plants as do not require a high temperature could be put into the ground. High temperature plants like tomatoes, cucumbers, squashes and melons were not planted out much earlier than the average. It remained cool and moist during May and June, then there were a few days of hot dry weather. Potato vines wilted, dropped to the ground and dried up. This was at first thought to be due to insects, then bacteria or fungi but was probably physiological, due chiefly to a lack of fertilizer, or moisture, or both.

Aphids were not troublesome in the orchard but in the vegetable garden they caused much damage particularly on potato, tomato, spinach, turnip, cabbage and nearly all kind of plants.

The Colorado potato beetle was present in usual numbers, and the three-lined potato beetle, clavate tortoise beetle and blister beetles were more abundant than usual in potato fields.

In orchards the false red-bug caused damage in certain sections of the State particularly in Fairfield and New Haven Counties. Its injury was also conspicuous in the dwarf apple orchard at the college at Storrs, at the time of the field meeting August 9.

The tent-caterpillar was almost entirely absent from apple and wild cherry trees throughout the State.

The brown-tail moth was also hard to find.

Peach borers were unusually abundant and troublesome in many orchards late in the season.

Scouting for the Oriental Peach Moth shows it to be present in the State and also calls attention to the presence of the peach twig borer *Anarsia lineatella.*

The squash borer was present in usual numbers during the season.

The elm leaf beetle seems to be on the increase and tussock moths were common on fruit and shade trees throughout the State.

There was some injury from white grubs and wire worms, and the stalk borer and corn ear worm have attacked corn in certain localities.

The gipsy moth has apparently not been distributed by windspread as in 1913 and 1916, though a few additional towns have been found infested. In the older and worst infested towns the number of infestations and number of egg-masses are both less than a year ago.

Flea beetles were very abundant and did much damage to vegetable crops, especially to potatoes, tomatoes, cucumbers and Chinese cabbage.

The European House Cricket *Gryllus domesticus* Linn. was discovered in the State at Shelton where one dwelling house was infested.

More detailed information regarding most of these insects will be found in the pages of this report.

MISCELLANEOUS INSECT NOTES

Larva on Tartarian Honeysuckle;—On June 6, 1918, a bright green larva tapering sharply towards both ends and with a black median stripe, was collected in New Haven on Tartarian Honeysuckle, by Mr. F. J. Reveley, supervisor of war gardens. On July 18, the adult emerged and proved to be an undescribed species of *Harpipteryx*.

The Clavate Tortoise Beetle, *Coptoclycla clavata* Fabr:—This insect was unusually prevalent in Connecticut on potato in 1918, being received from Clinton, Guilford, Meriden, Monroe, Plainville and Shelton and observed in many other places. An illustration will be found on Plate XVI, a, and a brief account of the life history of this insect on page 110 of Bulletin 208, which is a part of the annual Report of this Station for the current year, 1918.

Abundance of Potato or Cucumber Flea-Beetle, *Epitrix cucumeris* Harris:—This insect was extremely abundant on potato throughout the State and in New Haven attacked potato, tomato, cucumber and Chinese cabbage. The beetles persisted through May and June in spite of repeated sprayings. In July they were still present but not as abundant. As this insect has been discussed in Bulletin 208, page 103, which is a part of the annual Report of this Station it can only be mentioned here.

The Rose Chafer, *Macrodactylus subspinosus* Fabr:—This insect was somewhat less troublesome than in 1917, though it was present and did considerable damage. The adults appeared much earlier than usual, as Mr. Brown observed them at Clinton, June 1. The Entomologist collected two adults, June 2, in his garden. The earliest previous record was June 9, and usually the beetles appear about June 12.

Salt Marsh Caterpillar Feeding on Bean:—The Entomologist collected a hairy caterpillar August 24, 1917, feeding on bean in Westville; it was taken to the insectary, and in due course of time pupated. On May 25, 1918, a male moth emerged and proved to be *Estigmene acræa* Drury. The larva is called the "salt marsh caterpillar."

Abundance of Three-lined Potato Beetle, *Lema trilinata* Oliv:—This insect often known as the "old fashioned potato beetle" was more abundant throughout Connecticut in 1918, than I have

ever seen it during a residence in the State of nearly 25 years. It appeared early in June and fed for about a month. An account of its life history was published in Bulletin 208, page 109, with illustrations on plate XV, which is a part of the annual Report of this Station. Of course it can be controlled like the Colorado potato beetle by a spray of lead arsenate.

Birch Leaf Skeletonizer, *Bucculatrix canadensisella* Chamb:—This insect was very abundant in Connecticut in 1910 and was described in the Report of this Station for that year, page 701. Soon after it began to subside, and for the last five or six years has not been noticeable, but in 1918 the larvae were observed in New Haven, feeding upon the leaves of paper birch. We may fairly expect this insect to increase in abundance for the next few years, and all choice shade trees should be sprayed with lead arsenate to preserve their foliage.

Leaf-Tyer on Rose:—In the writer's garden in May 1918, small caterpillars were very abundant on some of the rose bushes tying together nearly all the leaves. Certain plants were almost defoliated. Specimens were gathered May 23, and placed in the insectary. On June 15, five yellowish moths had emerged. The wingspread is about half an inch, the forewings are pale lemon yellow marked more or less distinctly with transverse orange bands. The species is *Tortrix albicomana* Clem.

Schizura unicornis on Hickory:—On July 26, 1917, Mr. Zappe collected a small larva of the genus *Schizura* feeding on hickory in New Haven. More material was gathered July 31 and placed in the breeding cages. Dorsal portion of thoracic segments black; first abdominal segment has a horn with two projections or tubercles on it; anal segment has a horn bearing two hairs; both segments in front of the anal segment have white notches forming a triangle. On May 28, 1918, an adult female emerged, which proved to be *Schizura unicornis* S. & A.

The Saddled Prominent in Litchfield County:—Specimens of the Saddled Prominent *Heterocampa guttivitta* Walker were collected in Norfolk in 1917 by men of this Station working on the pine blister rust. The caterpillars were abundant and feeding on the leaves of the deciduous forest trees in Norfolk and vicinity. This insect was well distributed in 1917 but in 1918, it was even more abundant in certain localities and woodland areas a half-mile square, were stripped by them. The trees eaten were maple,

beach and birch. During September the writer was informed by Dr. H. T. Fernald of Amherst, Mass., that the Saddled Prominent had defoliated large areas of deciduous forest in 1918 in Berkshire County, Massachusetts.

Absence of Tent-Caterpillar:—The tent-caterpillar *Malacosoma americana* Fabr. which was so very abundant in 1913, 1914, and 1915, and since then has been waning was almost wholly absent in 1918. Mr. Brown who traveled about the state all summer searching for the Oriental peach moth reported on June 3, having seen four tent-caterpillar nests, one in his orchard in Clinton and three in Fairfield County. Mr. Stoddard of the botanical department, reports seeing one nest in Norfolk, and Mr. Davis of this department saw a few nests in Windham County. Two nests were also reported from Woodbridge. Apparently the tent-caterpillar is now at its lowest ebb and is being held down by its numerous parasites and other natural enemies. In a few years it may be expected to again become abundant.

An Orchid Weevil in Connecticut:—On December 14, 1917, some small black snout beetles were received from the greenhouses of Morton F. Plant at Eastern Point, Groton, said to be causing injury to orchids. Mr. Q. S. Lowry visited the place and collected more material. The species was identified as *Diorymellus laevimargo* Champ., and is only about 2 mm. long and 1 mm. broad and is black and shining. The beetles feed upon the leaves, flower-stalks and pseudo bulbs of *Cattleya* and are said by growers to injure the flowers. This weevil is a native of Central America and has been recorded by Mr. H. B. Weiss as occurring in orchid houses in New Jersey*. No recommendations regarding control measures can be made at this time, though in some houses the men are sent through to collect all the beetles that they can find. This weevil is shown on plate XXXI, b.

Chamyris cerintha Feeding on Privet:—On September 19, 1916, Mr. Q. S. Lowry collected in Stratford a striking caterpillar feeding upon the leaves of California privet. This larva had brown thoracic segments, abdominal segments black with creamy white lines on the middle ones. Segments very distinct. Head black. Anal pro-legs very long. Larva somewhat hairy. On September 28, the larva escaped from the breeding cage, but was found

* Entomological News, Vol. XXVIII, page 27, 1917.

boring into a piece of board. This piece of wood was placed in the breeding cage and the larva bored into the end of it and spun a fine silken cover over the top and pupated. The adult emerged July 20, 1917, and proved to be *Chamyris cerintha* Treit. This noctuid moth has a wing-spread of about one and one-quarter inches, is white with fore-wings prettily marked with small black spots near base and apex and wavy transverse bands of reddish brown, olive green and bluish gray. The larva is said to feed upon plants of the family Rosaceae.

White Woolly Larvae on Hickory:—On July 6, 1918, specimens were received from Mr. W. A. Muirhead of the Street Department of Hartford, of white woolly larvae feeding upon hickory leaves. The same species on English or Persian walnut was sent in from Meriden in 1917 by Mr. Harry L. Johnson, and Mr. Lowry collected it on Butternut in New Haven. This insect is *Erythraspides caryae* Norton, first described from Farmington, Conn., by Mr. Edward Norton who has placed it in both the genera *Mononphadnus* and *Selandria*. The larvae feed on the under side of the leaves. They are nearly an inch long, green, but their bodies are covered with long wool-like material obscuring the body color. It is sometimes called the "Butternut Woolly Worm" and usually appears in July. There is only one brood each year. The adult is a small-sized sawfly with black body, rufous thorax and white legs; wings are somewhat infuscated. The species is rather rare and is mentioned here because it is noticed more often as a curiosity than as a pest.

Chrysanthemum Gall Midge *Diarthronomyia hypogæa* Loew; This European insect was first reported in the United States by Dr. E. P. Felt,* State Entomologist of New York, who had received specimens from Prof. R. H. Pettit, of the Michigan Agricultural College, collected at Adrian, Mich. Since that time this pest has been recorded from California, Oregon, Michigan, Ohio, New York, Pennsylvania and Connecticut. It does not yet occur in every greenhouse where chrysanthemums are grown, but it is found in many of them. This pest is now being investigated in Connecticut, especially as regards control measures. The adult, a small two-winged fly lays eggs between the hairs of the leaves or stem particularly of the new shoots, and each larva forms a gall on the leaf, flower sepal or shoot, transforming in from 40

* Journal of Economic Entomology, vol. 8, page 267, 1915.

to 50 days within the gall. Several generations may occur in a season in the greenhouse. A thorough spraying every few days with nicotine sulphate solution (1-500) and soap is said to kill the emerging adults and a large proportion of the eggs. Mr. Zappe is now conducting tests for the control of this insect. Infested leaves are shown on plate XXXVI, b.

Calosoma sycophanta Linn;—This large European ground beetle was introduced into the United States because both larvae and adults devour gipsy moth caterpillars. It has been present in Massachusetts for twelve years and colonies have been planted in the adjoining states infested by the gipsy moth. So far as known this beetle has been planted in Connecticut only at the following points by the gipsy moth force:—Stonington, 1914; Thompson, 1915; Killingly, 1917. In 1914, a year before the planting of the colony in Thompson, one male adult was found in that town by a gipsy moth scout and sent to the parasite laboratory at Melrose Highlands, Mass. The species had evidently spread into Thompson from Massachusetts or Rhode Island. On May 24, 1915, Mr. Harry L. Johnson of South Meriden captured a specimen near his home, at least 40 miles in a straight line from any point where liberated in the gipsy moth territory. Few recoveries have been made in the vicinity where liberated but the species seem to have become well distributed, as in 1918, gipsy moth employes observed this insect in Thompson, Putnam and Plainfield: Mr. A. B. Champlain reports it from Old Lyme: an adult was received from Darien July 13: Mr. K. F. Chamberlain employed as an assistant in this department, collected a specimen in New Haven, July 29, 1918, and saw one or two others badly crushed upon the sidewalk.

The Stalk Borer in Corn *Papaipema nitela* Guen:—Every season a number of specimens are received from various sections of the State, of a larva boring in herbaceous stems. Sometimes it is potato or tomato, sometimes dahlia or lily. It has usually been easy to recognize the pest as the stalk borer *Papaipema nitela.* During 1918, however, this insect was received seven times from Greenwich, New Haven, Guilford, Litchfield and Bristol, and in each case it was attacking corn. The larvae begin to feed on the leaves at the whorl before the stalk shoots up, and on account of this habit it was thought by some to be the army worm. A little later these larvae tunneled in the stalks and some corre-

spondents mistook this insect for the European corn borer (see page 316) which has not yet been found in Connecticut though suspected a number of times, and which may occur here. The stalk borer has already been mentioned and illustrated in Bulletin 208, page 111 (plate XVIII, a and b) which is a part of the Annual Report of this Station for 1918. As a rule it is only a stalk here and there which is attacked. There is no good remedy other than destroying the infested stalks when noticed. One employee of the Station grows dahlias, and claims that by watching the plants carefully he can detect the borers before the plants begin to wilt. By injecting a thin mixture of lead arsenate and water, into the burrow by means of an oil can he kills the larva without further injury to the stalk.

The Poplar Girdler *Saperda concolor* Lec. var. *unicolor* Joutel:— This long horned beetle has long been known as a borer in small stems and branches of poplar and also certain small species of willows. A swelling or gall is formed around the burrow as is shown on plate XXXIV, b. The beetles emerge and the eggs are laid in May, and the accompanying illustrations show (plate XXXIV, a) the peculiar triangular areas marked out by incisions cut into the bark. A white oval egg is deposited at the apex of this area as shown on plate XXXV, a. The grub or larva hatching from this egg at first eats out a cavity under the bark as shown on plate XXXV, c, but later makes a transverse tunnel which partially girdles the twig or branch. In order to heal these wounds, the growth is rapid and forms enlargements or galls at the points of injury. The adult beetle is about one-half inch in length, and is black with closely appressed gray or yellowish-gray pubescence: antennae are black annulated with gray. This beetle is shown on plate XXXV, b. The variety was described by L. H. Joutel in Bulletin 74, New York State Museum, page 74, 1904. Dr. Felt has included *S. concolor* in his "Insects Affecting Park and Woodland Trees," page 474, 1906, but does not mention the variety *unicolor*. The type is supposed to be of western origin and the form occurring in the Eastern States is considered as variety *unicolor*. The beetle shown in the illustration was collected from the injured twigs in New Haven. There is only one generation each year, and the insect pupates and passes the winter in the burrows inside the twigs.

The Elm Leaf Beetle:—This insect has been rather scarce for several years in the shore towns of Connecticut and in some places spraying was discontinued. In 1913 and 1914 this pest was prevalent in some of the towns of Litchfield County especially at the higher altitudes of 1,000 feet or more, and stripped the trees in some cases. Spraying was then inaugurated in some towns to forestall further damage. In 1917 this beetle was quite abundant in Fairfield and many trees at Greenfield Hill in that town were defoliated. Additional injury was noticed in Manchester and Saybrook.

In 1918, adults were abundant in attics in Greenwich, and injury was reported from Goshen and West Haven. The entomologist visited West Haven on July 17th and in company with Mr. T. J. McGinness examined the elm trees on the green. Several large trees near the corner of Main Street and Campbell Avenue had been badly eaten and the leaves were falling. Several branches broken off in a thunder storm showed the work of the larvae, the leaves being badly riddled. The larvae were descending the tree trunks at this time, and were very dark in color—so much so, in fact, that we suspected them to be another species, which has occasionally been found on elm and since described as *Altica ulmi* Woods.* Consequently larval and pupal material was gathered and taken to the laboratory, but when the adults began to emerge on July 26, it was found to be the old offender, *Galerucella luteola* Mull., the elm leaf beetle. The larvae when gathered were uniformly dark gray, and did not show the broad yellowish dorsal stripe. Pupae could be gathered by the pint at the base of the trees.

On August 15, the entomologist appeared by request before the Board of Selectmen in West Haven, and explained the life history of the insect and the advisability of spraying the trees next season. This meeting resulted in an increased appropriation for the care of the trees, large enough to spray them properly in 1919.

A Tip Borer in Garden Physostegia:—On June 14, an amateur gardener living on Huntington Street near the Station, brought to the laboratory specimens of the terminal portion of the herbaceous

* Bulletin No. 273, Maine Agricultural Experiment Station, page 182, 1918.

stems of a cultivated species of *Physostegia*, which had been attacked by some insect causing the shoots to wilt. On examination a small greenish yellow larva, evidently a tortricid was tunnelling inside the stem. The egg was probably laid on leaves or stem and the larva first begins to feed in the tips of the unfolding leaves, then tunnels downward into the stalk. In no case had it descended more than three inches. This causes the tips to wither and there were wilted tips on every bunch of *Physostegia* stalks in the garden, though there were some stalks in each bunch not affected. A visit was made to the garden and fully two-thirds of all shoots in each clump were infested. Some material was gathered and placed in the rearing cages. On July 9, a small purplish brown moth emerged. This has been identified by Mr. Heinrich of the Bureau of Entomology as *Olethreutes hebesana* Walk. The larvae is about 10 mm. in length and 1.5 mm. in thickness; body greenish-yellow, head, legs and cervical shield, black; a few scattered lateral hairs borne on tubercles. Adult, wing-expanse about 13 mm. (one-half inch), fore-wings, dark purplish-gray or brown marked with black and light brown spots. An irregular spot on costal margin, the basal portion mottled with purple and black, and the distal portion mottled with brown and black. Rear wings, fringe and under surface of both front and rear wings uniform dark brown. This moth is shown on plate XXXI, a. No control measures can be recommended other than destroying the infested shoots in June.

A Rare Moth Attacking White Pine:—On October 17, 1917, larvae feeding on white pine were received from Miss L. C. Alderson, Greenwich. These larvae live in silken tubes extending through a globular mass of their droppings, the mass being two inches or more in diameter. A brief description of the larva follows: Length about one inch, light brown or tan with four narrow, black or dark brown longitudinal stripes, the middle ones being broader than the lateral ones; hair lines in the transverse sutures between segments and also irregularly arranged. Head light brown marked with black or dark brown patches. Legs and prolegs light brown unicolorous with ventral surface. Scattered hairs are borne on the head, and dorsally, ventrally and laterally on each segment. On June 19, 1918, an adult emerged, which has been identified as *Tetralopha robustella* Zeller, a species reported from Florida, Texas and Colorado. The species described

as *diluculella* by Grote is now considered as a synonym of *robustella*. The moth has a wing expanse of about an inch, of a general grayish-brown color, slightly more than a third and less than half of fore-wings at base, dark brown; beyond this is a broad transverse band of pearl gray with dark discal dot near center; apical portion grayish-brown, lighter than base and nearly uniform with color of rear wings. Under surface nearly uniform grayish-brown, the rear margins of fore-wings being somewhat lighter. No attempt has been made to work out the life history of this species. Both larva and adult are shown on plate XXXVI, a.

NOTE REGARDING AUTHORSHIP.

For bibliographical purposes, all matter in this report (Bulletin 211) should be credited to W. E. Britton except where otherwise indicated.

ILLUSTRATIONS.

All plates are from photographs. Plate XXIII, by W. O. Filley; Plate XXIX, a, after Quaintance and Wood, Bureau of Entomology, U. S. Department of Agriculture; Plate XXX, a, after W. C. O'Kane, New Hampshire Agricultural Experiment Station; Plate XXXIII, a, by K. F. Chamberlain; Plates XXI, XXII and XXIV by W. E. Britton; All others by B. H. Walden. Figures 7 and 12 were prepared by Mr. Walden from maps; figures 8 and 9 after Wood and Selkregg, figures 10 and 11 after Marlatt, Bureau of Entomology, U. S. Department of Agriculture; figure 13 after Kinglsey, Riverside Natural History.

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a. Spraying apple orchard with automobile truck power sprayer. Woodstock.

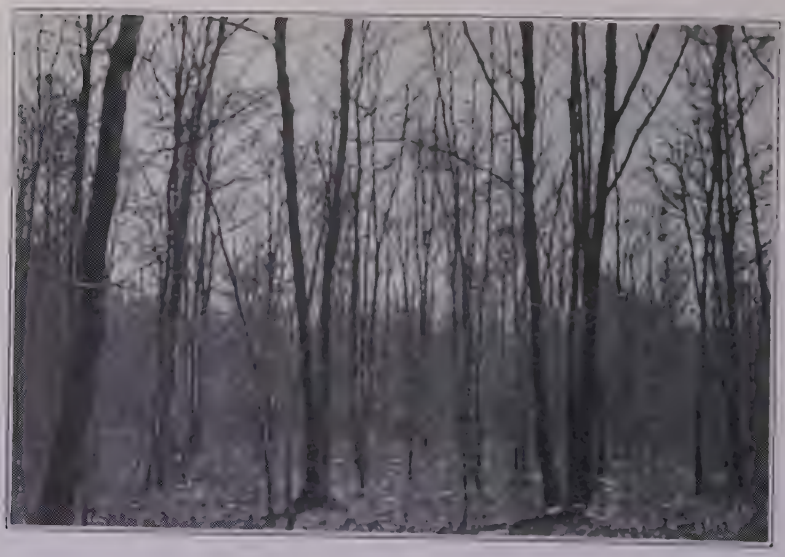


b. Another view in apple orchard, spraying with automobile truck power sprayer. Woodstock.

GIPSY MOTH WORK.



a. Automobile truck power sprayer.



b. View in woodland, Wareham, Mass., showing stripping by gipsy moth caterpillars, Photographed July 12, 1918.

GIPSY MOTH WORK.



View in stripped area, Wareham, Mass., at time of the visit of the Connecticut Finance Board, July 12, 1918.

GIPSY MOTH WORK.



Scouting for egg-clusters. This large white oak growing in the open had several egg-clusters. Woodstock.



a. Roadside scouting in Thompson.



b. Scouting in woodland near road, Thompson.

GIPSY MOTH WORK.



a. Old apple tree in Killingly, with hollow portion infested with egg-clusters.



b. On cutting off the hollow portion of the trunk it was found to contain 118 egg-clusters: 20 of these were old ones, and 98 were new.

GIPSY MOTH WORK.



a. This pasture white oak was infested, 12 old and 95 new egg-clusters being found. Killingly.



b. View showing the men scouting in an apple orchard. Thompson.

GIPSY MOTH WORK.

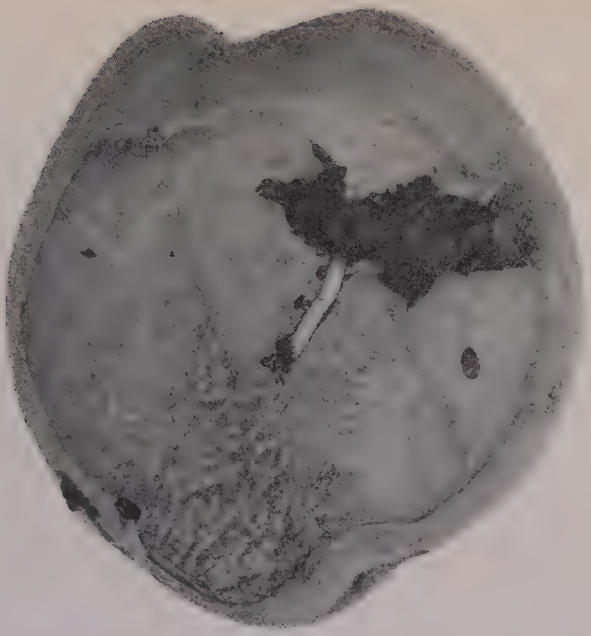


a. Heating water, slicing and melting the soap for making kerosene emulsion.



b. Mixing the kerosene with the hot water and soap.

POTATO APHID CONTROL.



a. Infested peach cut open to show larva. Somewhat enlarged. (After Quaintance and Wood, Bureau of Entomology, U. S. Department of Agriculture.)



b. Peach twigs which have been injured by the larvae. Natural size.

ORIENTAL PEACH MOTH.



a. Peach twig borer *Anarsia lineatella.* Adult, much enlarged.



b. The European corn borer, showing female, male, larva, pupa and burrow in cornstalk. Slightly enlarged.

PEACH TWIG BORER AND EUROPEAN CORN BORER.



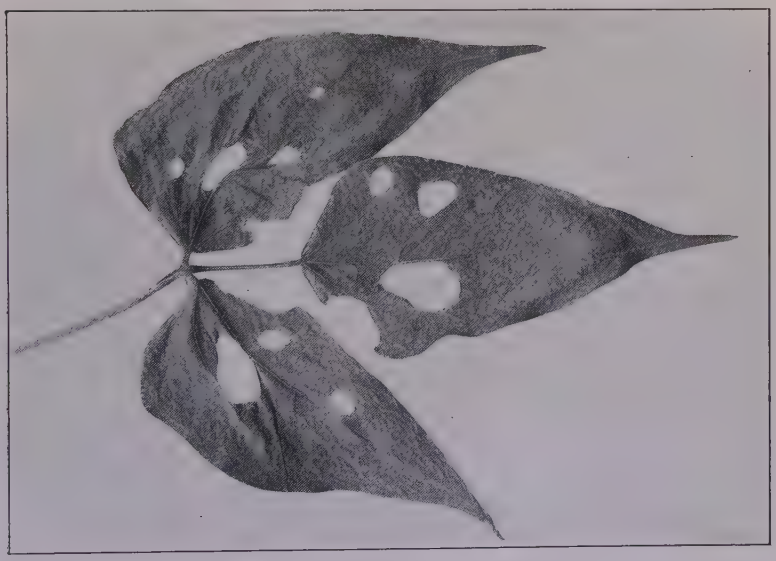
a. *Clethreutes hebesana* twice enlarged.



c. Bean leaf beetle, five times enlarged.



b. Orchid weevil, eight times enlarged.



d. Bean leaf injured by bean leaf beetle. Reduced about one-half.

BEAN LEAF BEETLE, ORCHID WEEVIL, ETC.



a. Larva on leaf, twice enlarged.

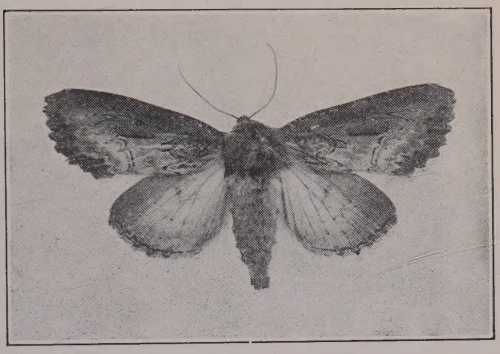


b. Leaves riddled by larvae, natural size.

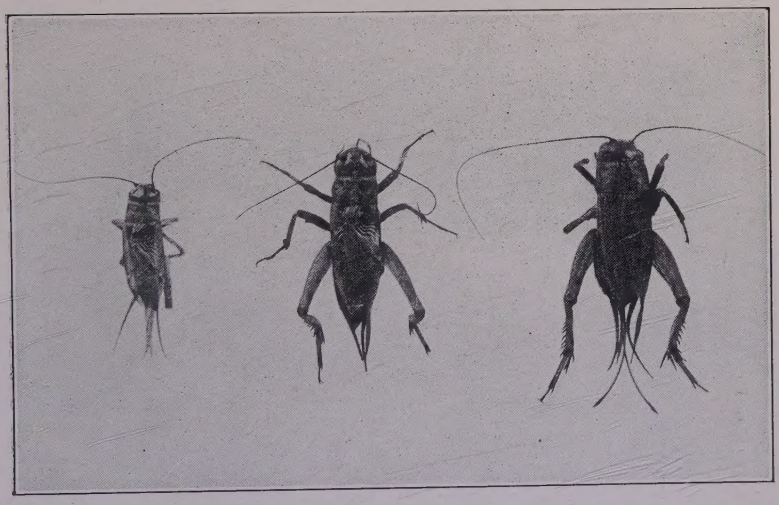
RASPBERRY SAWFLY.



a. Iris borer.
Natural Size.

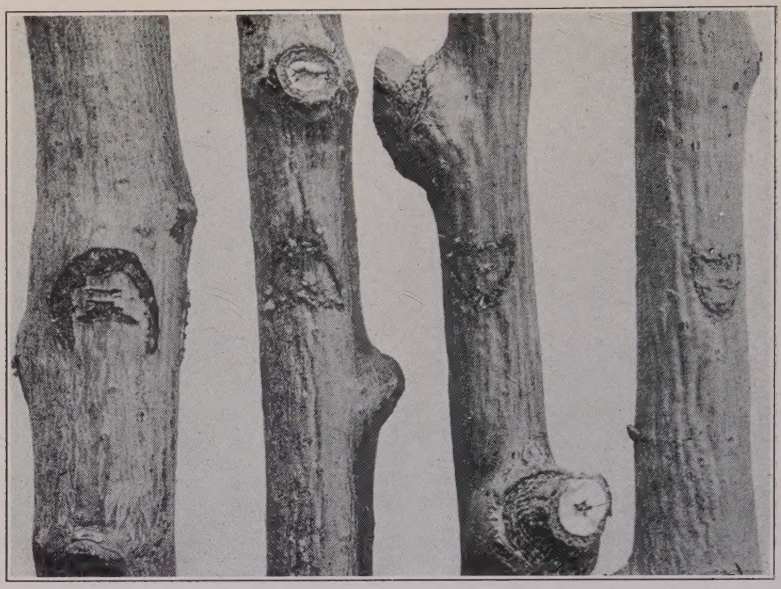


b. Adult of Iris borer. Natural size.



c. European house cricket. Somewhat enlarged.

IRIS BORER AND EUROPEAN HOUSE CRICKET.

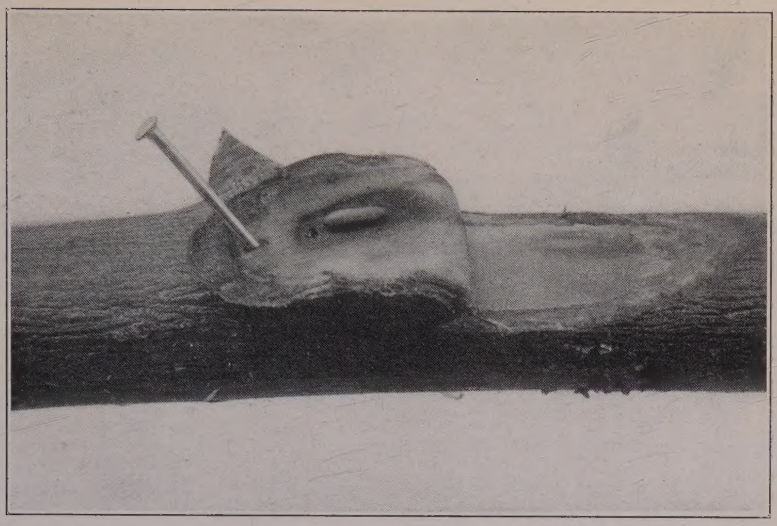


a. Poplar twigs showing triangular areas where eggs are laid. Twice enlarged.

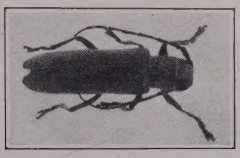


b. Poplar twigs showing tunnels and swellings. Natural size.

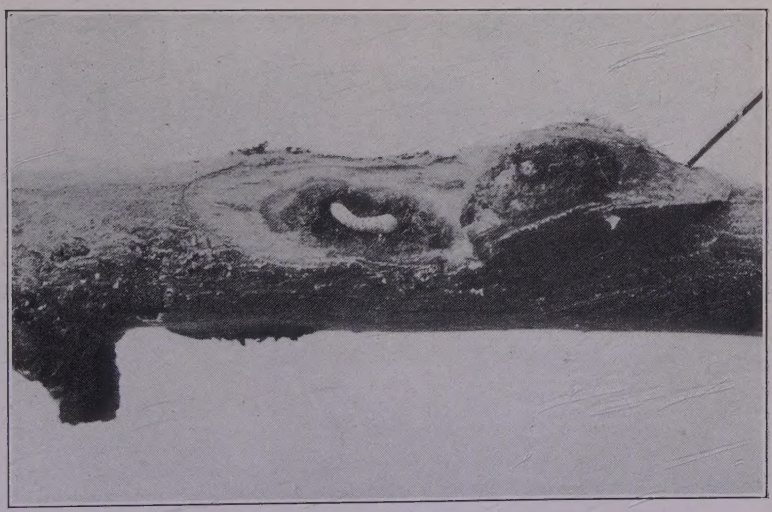
POPLAR GIRDLER.



a. Egg under bark, enlarged four times.



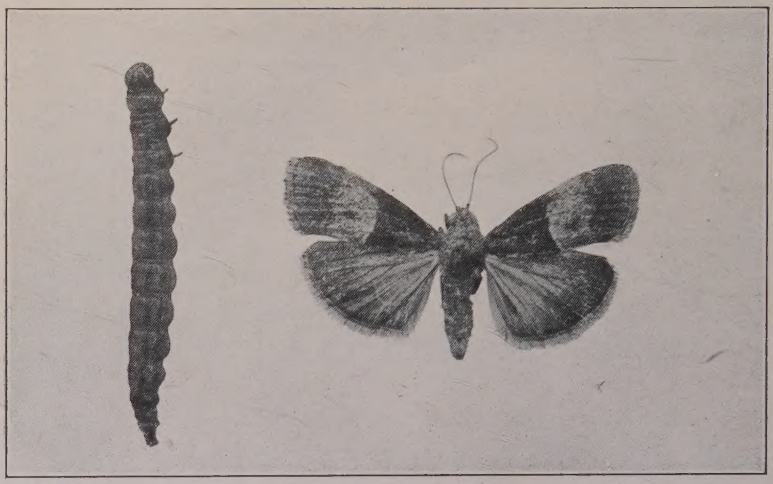
b. Adult poplar girdler. Twice enlarged.



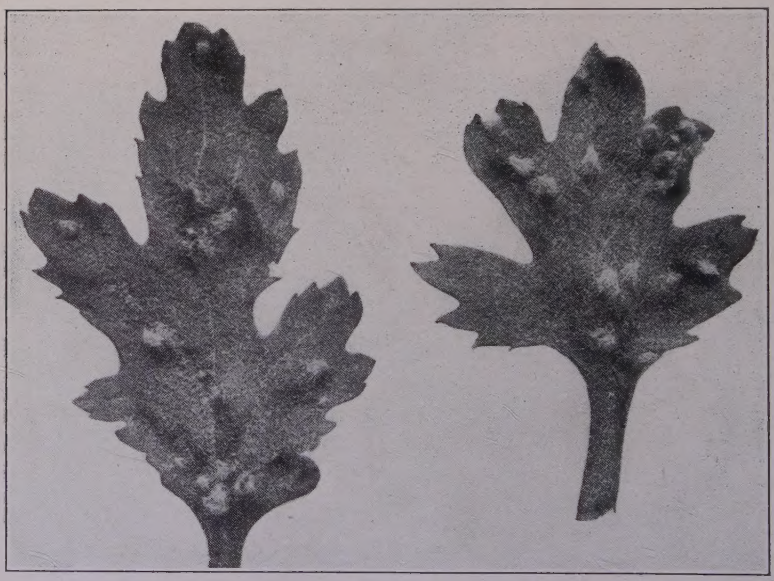
c. Young larva beginning to tunnel in twig, enlarged four times.

POPLAR GIRDLER.

PLATE XXXVI.



a. Larva and adult of *Tetralopha robustella*, a moth attacking white pine. Twice enlarged.



b. Galls on chrysanthemum leaves caused by the chrysanthemum gall midge. Twice natural size.

CHRYSANTHEMUM GALL MIDGE AND MOTH ATTACKING WHITE PINE.